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A Train-Order Signal Controlled by the Train Dispatcher

There are many cases where it is desirable that a train-dispatcher should be able to operate train-order signals along his division, and this applies especially to electric railways as there are operators at comparatively few points along these lines. Some special signal systems have been devised to meet these conditions, and we describe below a signal of this kind which is operated in connection with a telephone train-dispatching system. The signal is of the semaphore type, with operating mechanism, selective apparatus and telephone equipment contained in a box on the post. Fig. 1 shows

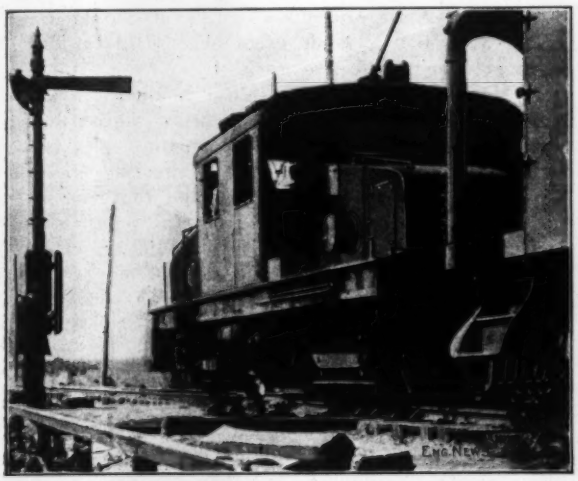


FIG. 1. ELECTRIC SEMAPHORE SIGNAL OPERATED BY TRAIN DISPATCHER · PIEDMONT & NORTHERN RY.

(The train has been stopped by the signal and the conductor is communicating with the train-dispatcher by telephone).

one of the signals on the Piedmont & Northern Electric Ry.; the signal has been set at the "stop" position by the train dispatcher in order to stop the train, and the conductor is at the telephone receiving instructions from the dispatcher.

The selector is one of the important features of this signal system, as it enables the dispatcher to operate any one signal at will. The selector is bridged directly across the telephone circuit and when the dispatcher wishes to throw any particular semaphore to the "stop" position, he operates a selector key. This sends out a number of direct-current impulses upon the line which operate a particular selector and no other. When this selector operates, it closes a circuit which bridges the semaphore-slot magnet across the telephone line, thus furnishing current to this piece of apparatus and energizing it. This, in turn, operates the semaphore. No local battery is required at the signal, all the current necessary being furnished from the signaling battery at the dispatcher's office. The selector is of the Western Electric type, which is used in connection with semaphore signals on a number of railways and which has a very low current consumption.

When the semaphore blade reaches a position approximately within 5° of the horizontal, it trips a special mechanism, and sends an "answer-back" signal to the office, giving a distinctive sound which informs the dispatcher that the particular semaphore has moved to the "stop" position. A train approaching the signal is of course, stopped and the conductor goes to the telephone to communicate with the dispatcher. When the conductor has received his orders, he sets the signal at its "clear" position, ready for future use. The signal mechanism is a simple electric slot, manually restored, and the dispatcher cannot clear a signal after having set it at the "stop" position.

FIG. 2. TELEPHONE BOX OPEN ON SIGNAL POST

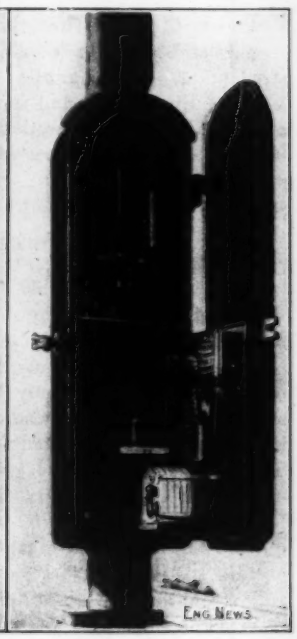


FIG. 3. MECHANISM BOX ON SIGNAL POST

The cast-iron box on the signal post has two doors, the outer one only being opened for ordinary use. When this is opened, as shown in Fig. 2, it exposes only the telephone receiver and transmitter, the generator handle, and the handle for restoring the semaphore arm to the

"clear" position. At the same time a shelf on the inside of the outer door drops into position, as shown, for the use of the conductor in writing the train-order with one hand while holding the telephone in the other. When the inner door is opened, as in Fig. 3, the apparatus is accessible for inspection and repair. The outer door is fitted with a gasket so that the box is weatherproof, and it can be opened only by a proper key. The telephone apparatus is weather-proofed, in order to withstand moisture, and all interior woodwork is treated with oil. The wiring and the design of the apparatus conform to good signal practice. All terminals are equipped with screws or lock nuts and are arranged conveniently for maintenance.

This selectively operated signal has been installed on the Piedmont & Northern Electric Ry., the Washington & Old Dominion Ry., and the Ogden Rapid Transit Ry. All of these are electric lines, but the system has an additional field in that it is applicable to steam railways, operating auxiliary train-order signals in connection with the telephone train-dispatching system now being introduced so extensively on steam railways. On divisions where night traffic is light and there are no night operators, the system can be used to supplement the day operators, as it enables the dispatcher to operate the signals and so get in touch with train crews at any desired point. This signal is manufactured jointly by the Western Electric Co. and the Union Switch & Signal Co., of New York, and we are indebted to the former company for photographs and other information.

Some Points in the Design and Construction of Reinforced Concrete*

By E. P. Wells.†

It is strange, at this present day, how many engineers and architects still adhere to the old specification of coarse grinding, consequently requiring aëration of the cement. It has been my lot only this week to come across a specification where it was stated the cement had to be spread on a floor for 21 days before being used. Those of us who are well acquainted with the present-day cement, and also its fine grinding, know how deleterious this is when great crushing strength is required. I think I have said, on more than one occasion at this Institute, that if cement is to be kept up to its full strength it is absolutely necessary that when it is received on the site of the works it should be stored in air-tight wooden bins; and if this is done cement may be kept for many years and be just as good after the lapse of time as it was when freshly made, whereas if the cement be stored in sacks, and even a very small amount of moist air plays upon them, then the cement is rapidly hydrated and cakes in the sack.

In a great many works that I have seen where failures have taken place, the failures have been very largely attributable to shuttering and strutting. I have in mind cases of beams deflecting two or three inches after the concrete has been filled into the mold, this being due entirely to the strutting sinking into the soft ground underneath. In several cases this has caused what appeared like shear cracks at each abutment, though the work afterwards stood the test load satisfactorily. Still, such cracks made the beam look unsightly, and there could not have been the same adhesion between the concrete and steel, owing to this settlement, as if the boxes had remained perfectly true and level during the whole time the concrete was being put in and until the same were struck.

I know of one case of a failure taking place entirely owing to the strutting sinking into the ground, the sinking taking place over more than a week. The concrete, therefore, never had the least chance of getting a fair adhesion to the steel, but was constantly being drawn away from it by this settlement of the strutting, so much so that when the strutting was removed the whole structure came down with a run.

It is always advisable, if there is any doubt at all about the ground, to have the latter tested beforehand, and it is far better to increase the sole-plates to double the size required, so as to prevent any possible chance of settlement, than to have an insufficient area with consequent settlement and trouble taking place.

Not only does the settlement cause a reverse camber of the beam, but also gives a fall in the floors the wrong way, and it needs extra expense all around to make good such defective work.

In this country, as a rule, water is almost invariably obtained from what is called a domestic source, namely, water supplied by large public companies who are extremely careful in what is sold to the public. Such being so, it is very rarely in England that one has to use water that does not come from the public supply, but there are cases where it is advisable carefully to examine the same before it is used. There are some places where the water is highly charged with gypsum compounds, and such being the case, it behooves one to see that there is no likelihood of failure taking place owing to an excess of this compound.

In the South of France, in Algeria, and in a great many districts waters are highly charged with gypsum, and so bad is this in places that concrete is absolutely dissolved and disrupted in less than two or three years. Whenever there is any doubt as to the quality of the water to be employed an analysis should be made beforehand, and so prevent what might lead to a disaster.

In a great many years of practical experience I have come to the conclusion that even if there is a large deficiency of steel in the structure both in tension and compression, and the concrete is of an excellent quality, there is hardly any chance of failure taking place, but if the steel is up to and even in excess of the requirements asked for, and by any chance the concrete is poor, then if an excessive load be placed upon the structure, there is nothing to prevent it failing.

A great deal has been done by the London County Council School of Building in educating clerks of the works and others as to the method in which the practical part of reinforced-concrete construction should be carried out. They ought to go a step lower and take in hand laborers who are connected with the carrying out of the work, because until such time as they themselves understand, to even a very slight extent,

*Portions of the Presidential Address before the Concrete Institute, London, Eng., Nov. 14, 1912.

†President, the Concrete Institute, London, Eng.

what is required of them, so long will they be careless in doing the work they have to do.

The foremen employed must be instructed to keep a sharp lookout on all of their men, and not to allow laxity in any shape or form. If the men know that the foreman is up to all their so called tricks of the trade, then they will take good care that the work is carried out in an efficient manner, but if by any chance the foreman is careless his workmen will be the same; and it will, I think, very often be found that where anything serious takes place it is not only the men but the foremen and even the clerk of the works on the job who are answerable for this state of affairs.

Any foreman who persistently makes mistakes in the carrying out of the work, after the same has been pointed out to him, should be dismissed and not allowed to undertake any work of the kind in the future. It is only by making examples of men who do bad work that one can expect an improvement to take place in the industry in this country. Works executed abroad, as a rule, are carried out by men who seem to take a great interest in their work. Even the ordinary laborer knows what he has to do and does it, whereas in this country there are so many instances of scamping, not only in reinforced work but also in other branches of structural engineering, that it is only strict supervision in the past that practically made our work some of the best in the world, though I have very clear remembrances before me of seeing wooden rivets and other such things being done, and I daresay there are many in this room who have seen likewise. We do not hear of wood being put in for steel in reinforced concrete, that is to say, by the designer, but many accidents have proved that wood has been put in and has been the cause of the mischief.

A point to which it is advisable, I think, for me to call attention to is electrolysis. I have watched one work where this mischief occurred, and only about a couple of months ago I made a further examination and found that the mischief was still increasing. It is a moot point with some as to whether there is any electrolytic action or not, but personally I have very little doubt upon the subject, so that it behooves all designers and contractors to see that there is no possible chance of electric currents finding their way into the steel reinforcing, because, should they do so, I do not think there is any doubt whatever that it will mean the eventual disruption of the concrete. It only requires the exercise of care to put a stop to this and to be perfectly certain that all cables throughout the reinforced-concrete work are properly insulated, and that there are no stray currents wandering about the work.

I think a great many of my hearers will agree with me in regard to the calculations of reinforced-concrete work that a great deal too much mathematics has been imported into the subject and that common sense has had to take a back seat.

If we were dealing with two materials, both of which were absolutely constant—that is to say, the concrete constant within a month after it was made in strength as the steel is immediately after it is rolled—then it would be possible to go in for mathematical formulas of a high order; but where you have a material—i.e., concrete—the strength of which, if all portions are good, is increasing day by day, and in some cases attaining a strength of three, four, or more times that which it was originally calculated for, how is it possible in these ways to formulate any formulas which are even moderately correct? It is far better to use more common sense and simplify or formulate empirical rules which you know are absolutely safe in their application. It is no good trying to extract the square root of two—it is useless. I have seen cases where the stresses have been worked out to five places of decimals, and it could all have been done by mental arithmetic, and the result would have been so close that it was really not worth while troubling about.

I see cases constantly where rods are put into work varied in diameter to 32ds of an inch. That is not at all necessary. It wastes time on the work, and in a great many cases a wrong rod goes into the wrong place. It is far better to adhere in all cases to commercial sizes, never advancing beyond 16ths of an inch and if possible advancing only by ⅛ths, as by that means the size of the rod is clear to the naked eye and does not require a caliper to be put upon it to find out whether it is $^{21}/_{32}$ or $^{22}/_{32}$. Such reinforcements as these simply show how designers lack common sense and bring the work into disrepute. Exactly the same thing takes place with calculations submitted for approval. A mass of figures will be carried out into millions where the whole lot can be simplified by reduction into tens or hundreds, and the elimination of anything beyond two places of decimals. The simpler calculations are made, the less liability there is of errors creeping in, and if an error does creep in, then it is much easier to discover; but where a whole foolscap page of figures is used to arrive at a result, it means in a great many cases simply disaster, as well as being also a waste of time and expense with a view to possibly saving a pennyworth of steel.

I have always been a great enemy to the complicated calculations, as I do not think they are at all necessary. It only brings to mind the largest building that has ever been constructed in London. I am now speaking of as long ago as about five-and-twenty years. In an arch rib there was a deficiency in the center of the span of, I think, half an inch in a large sectional area of steel. To make up this deficiency in compression a bar 2 in. by ¼ in. was riveted on, and this only for a length of two or three feet, thus making mathematics simply an absurdity, whereas no common-sense engineer would for the sake of half an inch in one hundred square inches ever think of doing anything so absurd.

The same applies to reinforced concrete. It is far better to work in all cases to commercial sizes of rods, even if there be a slight deficiency in sectional area, than to put in multiples of rods of all diameter so as to make up a given sectional area. This entails an enormous amount of work, not only upon the designer but also upon the foreman who has to take charge of the work, and upon everybody connected therewith, and it is of no practical value whatever. Therefore I should like to see in all rules made for reinforced concrete that common sense should enter more largely into the formulas that are given to the world.

A Proposed Standard Record of Street Traffic*

The Need for Traffic Records

Records of traffic on streets are of great importance and utility, as is known to all engineers connected with their construction. maintenance and use. The quantity and weight of traffic on a street or road has generally been one of conjecture and not based on actual count. A traffic regarded in small cities as numerous and heavy. is light traffic in larger ones; although in both places it passes over the same kind of pavement and is under other similar conditions. Although the engineers of the Department of Bridges and Roads of France, who have charge of construction and maintenance of streets and roads of that country. have, this 50 years, recorded traffic and reduced it to the quantity per meter of width, there has been comparatively little done in other countries. London, Berlin and a few other European cities have taken some records. In the United States it was not until 1885 that records were taken on a few streets of ten cities and more for the purpose of promoting a special class of pavement, then little used, than to determine the relation of quantity of traffic to wear, cost of maintenance of pavements and other important factors. Since 1900, records of various kinds have been made at a few places in several cities, as the importance and great cost of pavement and road construction and especially maintenance, have been recognized.

There is, as yet, no standard method for recording and comparing the traffic on different streets of a city, nor traffic on streets of one city with those of another. The object of this report is to suggest a uniform method of recording, analyzing and standardizing quantity and weight of traffic on streets and roads, and for reducing it to unit bases of quantity and of tons per yard of used traffic width of roadway per day, or per square yard of used roadway surface which is the same thing.

The two legitimate causes of wear and destruction of pavements are traffic and weather. In some cases where traffic is very light and the weather severe, the latter does the greater damage. Usually the traffic is a greater cause of wear than weather, but in every case traffic must be considered. Whether or not a pavement has been properly constructed with durable foundation and a wearing surface of any one of the many kinds in use and the pavement properly maintained or not, traffic records give very important data on which to base the selection of future pavements, to estimate the value of first construction and the cost of maintenance. Traffic records show the approximate cost of maintaining the kinds of pavements which add to the comfort and health of people using them or living near them. These records are also essential for handling traffic and effective city planning and administration. They show how to relieve traffic congestion by constructing new thoroughfares and their relations to old ones, what streets must be widened; what streets can have their roadways made narrower to reduce cost of paving and cleaning, and for beautifying them by parkways or otherwise.

*From a report of the Committee on Traffic on Streets and Roads. (J. W. Howard, Chairman, 1 Broadway, New York City); annual meeting of the American Society for Municipal Improvements, Dallas, Tex., Nov. 14, 1912.

This report is based on official traffic records of several European and American cities, made at various intervals during the past 39 years, supplemented by personal knowledge of many of the streets and experience in making actual traffic records. The various and widely divergent analytical records, made in the past few years at a few points in the United States, have been consulted. Most of these records have failed to state the width of the streets or roads and are defective in other respects. Many cannot be reduced to any unit basis for comparison with each other. Many have unnecessarily subdivided the vehicles into too many kinds, sizes, etc., by methods which are complicated and unnecessary for practical, general use.

Proper Traffic Records.

Traffic records should be based on a simple, accurate method of counting and recording traffic and reducing it to standard units of quantity and tonnage. The method should be such as to be quickly understood and applied. This report presents such a method with forms for practical use.

The period during which traffic should be counted is for 12 consecutive hours from 7 a.m. to 7 p.m. and during six consecutive or other different week-days. If average weather and what is known to be average traffic conditions are selected, then a record for only three consecutive week-days gives valuable information. No traffic should be counted in abnormal seasons of snow and ice, nor during continuous rainy, very cold or excessively hot days. The foregoing applies to all cities. Nevertheless, local special conditions on a few principal thoroughfares of cities, say above 500,000 inhabitants, sometimes require records of traffic during the 24 consecutive hours of each day for several days. The location where the traffic is counted must be at or near the center of a block and not at an intersection of two streets. The traffic is that which passes both ways along the street or road. It can well be counted from the sidewalk or

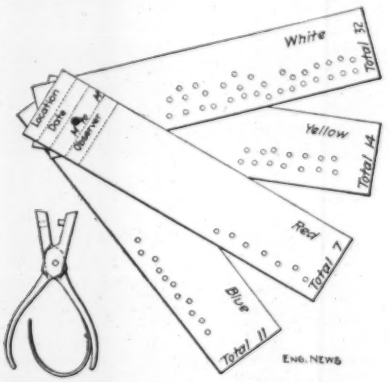
TRAFFIC ON DIFFERENT STREETS AND ROADS

		Totals on whole width of roadway		Total per yard effective width of roadway		Relative intensity of degree
Place	Street	Vehicles	Tons	Vehicles	Tons	of traffic
Paris	Rivoli St.	33,232	49,041	2767	4087	Sixth
Paris	Opera Av.	29,460	42,216	1789	2558	Sixth
Paris	Madeline Bl.	17,524	24,776	1019	1385	Sixth
Paris	Italiens Bl.	20,124	27,651	1093	1500	Sixth
Paris	St. Honore St.	16,598	22,952	1976	2732	Sixth
Berlin	Potsdam Pl.	14,221	39,656	1016	2832	Sixth
Berlin	Leipzig St.	9,596	26,139	720	1961	Sixth
Berlin	Friedericha Pl.	13,479	33,529	963	2395	Sixth
London	Strand	16,208	27,878	1430	2460	Sixth
London	Cheapside	11,019	18,953	1136	1954	Sixth
London	Gracechurch St.	12,148	20,894	1149	2154	Sixth
New York	5th Av. nr 58 St.	8,665	12,091	673	946	Fifth
New York	First Ave.	2,301	3,391	131	192	Third
New York	Bway. nr. Fkln.	3,277	3,554	266	288	Fourth
New York	Wall St.	2,443	3,555	305	444	Fourth
New York (Queens)	Hillside Ave	1,304	1,529	157	184	Third
(Bronx)	White Plains Rd.	342	536	49	75	First
Washington	Fifteenth St.	4,687	6,456	335	461	Fourth
Washington	Ninth St.	1,965	2,478	123	155	Third
Chicago	State St.	6,048	(x)	430	(x)	Fourth
Chicago	Clark St.	4,691	7,728	335	552	Fourth
Chicago	Wabash Ave.	3,794	8,643	237	590	Fourth
Chicago	Sheridan Rd.	5,736	11,925	465	994	Fifth
Philadelphia	Broad St. N. Chest.	6,176	11,154	105	697	Fifth
Philadelphia	Filbert St.	5,185	8,102	576	900	Fifth
St. Louis	Locust St.	3,496	5,308	318	482	Fourth
St. Louis	Broadway	3,150	4,976	197	311	Fourth
Buffalo	Main St.	2,941	3,836	166	217	Third
Buffalo	Linwood Ave.	897	1,541	60	129	Second
Boston	Devonshire	5,410	7,380	676	923	Fifth
Boston	Kilby St.	3,503	4,555	455	591	Fourth
Newark, N. J.	Broad St.	2,400	(x)	126	(x)	Third
Newark	Bridge St.	2,522	(x)	205	(x)	Fourth
Massachusetts	Shrewsbury Rd.	484	770	97	154	Second
Massachusetts	Medford Rd.	434	599	47	72	First
Massachusetts	Weston Rd.	964	1,260	161	210	Third
Rhode Island	E. Providence Rd.	463	172	77	112	Second

other convenient location, and best from a room with the window facing the street.

In order to determine the total traffic on a street or road and so tabulate it that the results can be reduced to standard bases, and do this at least possible expense and by simplest method, certain items or factors must be carefully noted as shown in the accompanying forms.

The *general classification* of vehicle traffic for practical results, is as follows: (1), *horse vehicles;* subdivided into one-horse, two-horse, three- or more horse; (2), *motor vehicles.*



SLIPS FOR RECORDING TRAFFIC COUNTS

(Form I. Report of Committe on Street and Road Traffic, American Society for Municipal Improvements; J. W. Howard, Chairman, New York City).

The vehicles and horses must both be considered in computing the weights, etc., of traffic from the quantities counted and recorded. This is because they both occupy space on a roadway and both help wear and injure the surface. Experience has shown that for general traffic counting and the reduction of the quantities of vehicles to tonnage of traffic, the average weight of all vehicles (empty and loaded) drawn by one horse can be taken as one ton (2000 lb.); by two horses as two tons; by three or more horses as four tons. In like manner the average of all motor-vehicles (loaded and empty) for transportation of persons and goods can be taken as 1¾ tons. All bicycles and ridden horses, because light and very few, are best omitted from street traffic records. If ridden horses are at all numerous on a park, suburban or country road, they are best recorded and estimated as one-horse vehicles. Unusual subdivision of vehicles into sizes and kinds, also street cars on their rails, and other data in special cases, can be recorded on separate slips. But this adds greatly to the difficulty of recording correctly and seldom furnishes any needed or practical information as far as streets themselves are concerned.

The forms for counting and recording traffic, hereto attached, are self-explanatory. They should be explained and distributed in advance to the traffic observers or recorders.

TRAFFIC COUNTING SLIPS (FORM I)—This consists, as shown, of sets of four cardboard slips, about 2x9 in. fastened together at the end; 12 sets are needed, one set being used for each hour. If traffic is very numerous, one or more extra sets can be used for one hour. Each set is marked for location where traffic is counted, name of observer, date, the hour represented by the set (as 7 a.m., to 8 a.m., etc.). There must be at least two observers for each location, to relieve each other at the end of each hour or two hours, because one recorder cannot work accurately for a longer period. An ordinary conductor's punch is needed and a hole is punched in a slip for each vehicle passing in either direction along the street in front of the recorder. One-horse vehicles are punched in the white cardboard, two-horse in the yellow, three- and more horse vehicles in the red; all motor vehicles are punched in the blue slips. The number of

FORM II. ONE-DAY TRAFFIC RECORD

12 hours from 7 a.m. to 7 p.m. Date.....19.... Day of week.....

City.....State.....

Location of observer, on.....St. (or Ave.) bet.....St. (or Ave.) and.....St. (or Ave.)

Width of roadway bet. curbs at place of observation.....yd.

Effective traffic width (1 yd. less than full width).....yd.

Kind of pavement; stone block.....; sheet asphalt.....; or.....;

Quality of surface of pavement; new and even.....; old and slightly uneven.....; very uneven.....;

Condition of surface of pavement; wet.....; dirty.....; clean.....;

Weather; rain.....; fog.....; dry.....; approx. temp.....°F.

Street-car rails present; single track.....; double track.....;

General kind of rail; flat with groove.....; L shape.....; T shape.....;

Average approximate speed of horse vehicles,.....mi. per hr.

Average approximate speed of motor vehicles,.....mi. per hr.

Remarks;.....

Between hours	No. horse vehicles: 1 horse	2 horse	3 or more horse	Total horse vehicles	Total motor vehicles	Total tons horse vehicles	Total tons motor vehicles	Total no. all vehicles	Total tons all vehicles	Total vehicles per yd. effective width	Total tons per yd. effective width
7 a.m. to 8 a.m.											
8 a.m. to 9 a.m.											
9 a.m. to 10 a.m.											
10 a.m. to 11 a.m											
11 a.m. to 12 m...											
12 m. to 1 p.m...											
1 p.m. to 2 p.m...											
2 p.m. to 3 p.m...											
3 p.m. to 4 p.m...											
4 p.m. to 5 p.m...											
5 p.m. to 6 p.m....											
6 p.m. to 7 p.m...											
Totals for 12 hr...											

Note:

1 horse vehicles average—1 ton
2 horse vehicles average—2 tons
3 or more horse vehicles average— 4tons
Motor vehicles average—1¾ tons

Signatures of observers:

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FORM III. FINAL CONSOLIDATED TRAFFIC RECORD

Period observed.....days of 12 hr. each. 7 a.m. to 7 p.m. Date.....19....Days of week.....
City.....State.....
Location of observer, on.....St. (or Ave.) bet.....St. (or Ave.) and.....St. (or Ave.)
Width of roadway bet. curbs at place of observation.....yd.
Effective traffic width (1 yd. less than full width).....yd.
Kind of pavement; stone block.....; sheet asphalt.....; or.....;
Quality of surface of pavement; new and even.....; old and slightly uneven.....; very uneven.....;
Condition of surface of pavement; wet.....; dry.....; dirty.....; clean.....;
Weather; rain.....; fog.....; dry.....; approx. temp.....°F.
Remarks:.....

Days	Total No. of vehicles		Total tons horse vehicles	Total tons motor vehicles	Total no. all vehicles	Total tons all vehicles	Total veh. per yd. effective width	Total tons per yd. effective width
	horse	motor						
1st day.....								
2nd day.....								
3rd day.....								
4th day.....								
5th day.....								
6th day.....								
Totals.....								
Aver. per day of 12 hr.								

Compiled by:
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holes in each are not counted until after a recorder stops observing the traffic. He can count the holes when relieved by the other recorder or at the close of the day's work. On counting he should write on each slip the total number of holes in it.

ONE-DAY TRAFFIC RECORD (Form II)—This consists, as shown, of a consolidated record of the quantity of traffic during each of the 12 hours from 7 a.m., to 7 p.m., with totals and reductions to unit bases. It gives details of name of city, width of roadway, effective width used by traffic, which averages ½ yard less on each side or 1 yard less than the full width between curbs or edges of the street. The kind or quality of pavements, the weather and other needed facts are shown. This form reduces the one day's traffic to standard units which are the total vehicles and total tons of traffic on the whole street; also per yard of effective width of the street. This is the equivalent of number of vehicles and tons per square yard of used roadway surface.

CONSOLIDATED TRAFFIC RECORD (Form III)—This form, as shown, is compiled from records on several Forms II. It consists of a condensed statement covering the six or other number of days' traffic. It shows the data day by day, together with the final totals and the averages per day. These totals are reduced in quantity and tons to the standard units of yard of effective width (square yard) of roadway surface subjected to the traffic. These are the true bases for comparing the traffic of one street with another and for establishing the relation of different amounts of traffic to wear on pavements, cost of maintenance and many for other useful purposes.

Traffic records are seldom needed annually; but at longer intervals up to once in five years or according to local changes of traffic conditions and other necessities in cities, counties or states.

In connection with the foregoing description of how traffic can be simply and accurately recorded and reduced to standards of quantity and of tons per yard width of roadway, the accompanying actual records of traffic in various representative cities and on a few surburban and country roads, will aid in establishing a basis showing the various degrees of intensity of traffic; first, very light; second, light; third, moderate; fourth, heavy; fifth, very heavy; sixth, extra heavy.

These quantities are compiled and computed from old official and later traffic records and are excellent illustrations of quantities, tonnage and degrees of intensity of traffic per yard of effective width or used roadways. In a few cases the records were made in such different ways and without proper classification of vehicles, that the data, in such cases, are not complete. The traffic is the average of several days of 12 hours from 7 a.m. to 7 p.m. or in a very few cases, a close approximation.

As soon as cities, counties and states have recorded, tabulated and reduced the traffic on their roadways, on the standard bases and units set forth in this report, then they will have accumulated very valuable data for comparing the results between the streets and roads of the same and other places. This data will be of much assistance thereafter in economically and efficiently solving all problems connected with the construction and use of all arteries of public travel and transportation.

Electricity-Supply Contracts of the New York Edison Co., New York City, with Gimbel Bros. (department store) and the Broadway Realty Co. (office building) have been held discriminatory by the Public Service Commission for the First District. In the case of the contract with Gimbel Bros. the Commission finds that the Edison company has been supplying electric current at a net cost of 2¼c. per kw.-hr., when the published rate for such service was not less than 3c. This was accomplished by two contracts, in one of which the company agreed to supply electric current, in excess of a certain amount annually, for 3c., and in the other the Edison company agreed to rent from the firm space in its basement for a substation and to pay therefor as rental, the difference between 2¼c. per kw.-hr. and the price charged under the other contract for electricity.

The Edison company, it is held, should have contracted to pay the market value of the space rented, leaving the customer to pay the rate paid by every other consumer of the same class. The making of the rental dependent upon the quantity of current consumed in one building, reads the opinion, "could hardly fail to result in actual discrimination during some part, if not during the whole, of the time covered by the lease."

A Report on Locomotive Headlights by the Wisconsin Railroad Commission

The Railroad Commission of Wisconsin has made extended tests of certain headlights in order to determine whether they meet the requirements of the new state law, which specifies that locomotives (on railways over 50 miles in length) must be equipped with headlights of sufficient illuminating capacity to enable the enginemen to distinctly discern an object the size of a man at a distance of 800 ft. This law went into effect on July 1, 1912.

The report made by the Commission (under date of Dec. 4, 1912) states that the investigations covered the following headlights: 1, the standard type of oil headlight with 16-in. case, and the Bunn safety oil headlight with 16- and 18-in., lenses; 2, the Commercial acetylene headlight, with 18- and 27-in. reflectors; 3, the Pyle-National and American electric arc headlights. The Commission had in view the necessity of guarding the safety of operation of trains and the investigations were conducted, therefore, along two general lines: 1, to determine whether the light given by the headlight was sufficient to comply with the provisions of the law; 2, to determine whether the headlight might endanger the safety of operation of trains through interference with signal lights or in any other way.

The efficiency of the various headlights with respect to visibility of objects on the track was observed in a number of road tests, at which a large proportion of the observers were men in the employ of the various railways in the state. Later observations were made by the Commission's staff from the cabs of engines in regular service and while on their regular runs. The tests relating to safety of operation consisted of observations made on signal and switch lights, a large proportion of the observers being railway men in regular service. During these tests all observations were taken while the observers were stationary, and the results obtained revealed the necessity of making further examinations of the high-power headlights in regular operation with the train moving. Such examinations were made by the Commission's staff by riding upon engines equipped with these headlights while on their regular runs.

The following is a brief statement of the results of the studies made of the various lights, as presented in the Commission's report:

OIL HEADLIGHTS

Observations made at the road tests together with those made in actual operation, indicate that none of the oil headlights fulfill the requirements of the law.

ACETYLENE GAS HEADLIGHTS

Observations on the headlight having a 27-in. reflector were not conclusive, as the reflector was defective. The observations on the one having the 18-in. reflector indicated that the acetylene headlight equipped with a cluster of three burners (each having a capacity of ½ cu.ft. of gas per hour) and the 18-in. reflector fulfills the requirements. An acetylene light in regular service, having a double burner and a reflector that had been poorly maintained, did not give satisfactory results. Another in regular service, having the double burner and a well polished reflector, was much more satisfactory. It is believed that it will be necessary to maintain the reflector in a high degree of efficiency and to use the cluster of three burners in order to obtain satisfactory results with this type of light.

ELECTRIC HEADLIGHTS

Observations both at the road tests and in regular service indicate that the electric arc headlights mentioned fulfill the requirements of the law. There are some features, however, connected with the operation of arc headlights on locomotives, which should not pass unnoticed: (1) Liability of reflected light from the roundels of signals whose lights have become extinguished or have burned low, being mistaken for a clear indication. (2) Difficulty of distinguishing classification lights and engine numbers on locomotives equipped with arc headlights. (3) Dazzling effect on yardmen, flagmen and others who are required to perform their duties in the rays of these strong headlights.

As for the first item, observations made by the Commission's staff on electric headlights in actual service, with the engine moving continuously at usual speeds, demonstrate the fact that dangers from this source are not nearly so great as indicated by the earlier tests at which the observers were invariably stationary while the readings were being taken. While numerous phantom lights were detected in the regular service tests, they were not of such a nature as to cause serious confusion to the trainmen. It was also found that the position of the blades becomes visible, in general, before the phantom lights are seen, and that these phantom lights are much in the nature of mere flashes when the engine is running at the usual speeds. As for the second item, it is believed that some precautions should be taken to place classification lights and engine numbers at such a distance from the headlight that the latter may not materially interfere with correct reading of them.

As for the third item, it is believed that the arc lights should be switched off while the train is passing through large yards, as well as at other points when it may have a tendency to interfere with the performing of duty by yardmen, flagmen, etc., or to endanger their lives. An incandescent lamp should then be switched on, its illuminating capacity being sufficient to act as a marker for the engine and to give warning of its approach. This means should also be employed on engines carrying color signals or markers when it is necessary that the fact be made known to the crew of another train or to other interested parties. It can also be used in case there is any confusion of signal lights resulting from the high power of the headlight. It is believed, however, that the electric headlight does not endanger the operation of trains either on single or double track, provided precautions such as those above outlined are observed.

The investigations are not conclusive as to the use of the electric arc headlight on roads equipped with the disk type of signal. A brilliant reflection is cast by this light from a plain glass surface of the size used in front of the large disk for day indications. The small disk for night indications is located a few inches above this large glass surface, and it is possible that the brilliant reflection from the latter may interfere with the correct reading of the night indications. The lack of blades to serve as a check is another feature which differentiates this signal from the semaphore type. Careful tests should be made to determine this point before the attempt is made to operate electric arc headlights on a road thus equipped.

It should be borne in mind that these investigations have covered only the headlights named, though from some inconclusive observations it would appear that there are other types of power headlights now on the market that may be expected to give good results, both as to illuminating capacity and freedom from objections as regards the safety of train operation. There are also other makes of arc headlights which probably compare favorably with the two investigated, and to which the same objections might be raised as those above enumerated.

⁂

The Raising of the Assuan Dam, described by F. H. Fowler in Engineering News, Sept. 30, 1909, p. 339, is now completed. Formal acceptance of the work by the Khedive of Egypt took place on Dec. 23, 1912.

Largest Working Force at Panama—Forty thousand, one hundred and fifty-nine persons were at work on the Canal and railroad at the close of November, the largest force in the Canal history. Of the total all excepting a few hundred women and children were men, and 5816 were white Americans. This condition is due mainly to the employment of 3499 men by the contractors on lock gates and similar work, and the development of the lock machinery erection under the Assistant Chief Engineer.

A comparison with the greatest force of past years follows:

Year	Month	Force
1907	October	31,967
1908	April	33,170
1909	October	35,405
1910	March	38,676
1911	December	37,826
1912	November	40,159

—"Canal Record," Dec. 11, 1912.

Reinforced-Concrete Ore Docks

SYNOPSIS—The ore-traffic on the Great Lakes has many special and unusual features, among which are its great extent (30,000,000 to 40,000,000 tons annually) and the necessity of handling the greatest possible tonnage between the opening of navigation in the spring and its closing by ice early in the winter. Three special features are provided to meet these conditions of the traffic: 1, Large steamers carrying great quantities of ore, with special designs of hull and special hatchway construction (in the form of frequent narrow hatchways extending almost the full width of the deck) to facilitate loading and unloading. 2, Ore-loading docks at the shipping ports on the upper lakes, where ore is dumped from cars into pockets at such a height that it can be delivered by gravity to the vessels through a series of inclined spouts extending from the ore pockets to the ships' hatches. 3, Ore-unloading machinery at the receiving ports so that the vessels can be unloaded rapidly and started back for a new cargo. The article given below deals with the ore-loading docks, and particularly with modern docks of reinforced-concrete construction, which are an economical advance beyond the old timber type of dock. Elsewhere in this issue is a description of an ore-loading dock of steel construction.

The special features of the ore-shipping ports on Lake Superior and Lake Michigan are the docks or piers from which the ore is delivered to steamers and barges for transportation to receiving ports on the lower lakes. These piers have long and high superstructures, the upper part forming a series of pockets into which the ore is dumped from cars bringing it down from the mines on the iron range, and from which it is delivered to the ships by gravity through long inclined chutes. There are at present 27 of these ore docks at six American ports owned by eight railways and having a combined capacity of about 1,440,000 tons. The docks are utilized to store the ore only in readiness for the steamers. As navigation is stopped for four or five months in the winter, rapid loading is essential in order to enable the vessels to make as many trips as possible during the open season. For this reason great length of dock is important, to accommodate several vessels, while of equal importance are the facilities for discharging the ore into the vessels. The chutes are about 12 ft. apart, corresponding to the spacing of the hatches in the decks of the ships.

In the majority of these ore docks, the superstructure is of massive timber construction, and as the life of this averages only about eight years, the expense for maintenance and renewals is heavy. In addition, there is always risk of damage or destruction by fire, which might have serious results in delaying the ore traffic. Under these considerations and especially in view of the increasing cost due to the decreasing supply of suitable timber, attention has been given to the introduction of other materials of construction, which, while more expensive in first cost, would be ultimately economical owing to their more permanent character, longer life, very small fire risk and greatly reduced cost of maintenance. The available substitutes for timber are steel and concrete, and both of these have been adopted in ore piers of recent date. In this article we deal with concrete construction, but a steel ore dock is described elsewhere in this issue.

The reinforced-concrete ore dock of the Lake Superior & Ishpeming R.R., which is described in detail below, is the second built of this material, the Great Northern Ry. having built one in 1911. The two designs are essentially different, however. In the earlier one, the reinforcement consists of a limited amount of steel rods; in the later one, the steel reinforcement forms a self-supporting structure which was erected in advance of the concrete work. For purposes of comparison we give at the end of this article some particulars of the earlier structure.

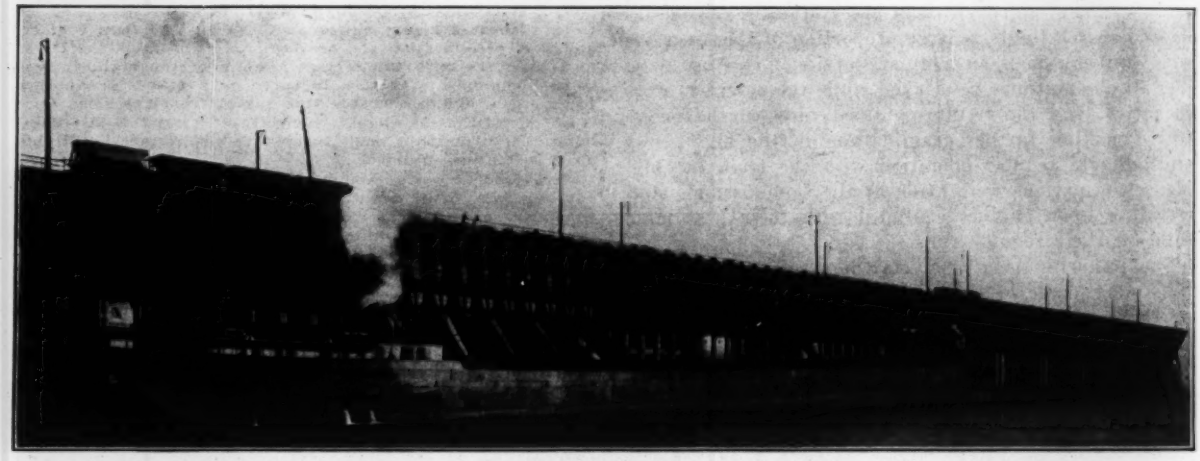

FIG. 1. REINFORCED-CONCRETE ORE DOCK AT MARQUETTE, MICH.: LAKE SUPERIOR & ISHPEMING RY.
(J. F. Jackson and R. C. Young, Designers. J. E. Greiner, Consulting Engineer.)

REINFORCED-CONCRETE ORE DOCK; LAKE SUPERIOR & ISHPEMING R.R.

This new ore dock was completed only recently, and is located at Presque Isle Bay, Marquette, Mich. As already noted, it has the special feature that its steel

reinforcement forms a self-supporting structure which was erected in advance of the concreting. The design was prepared by J. F. Jackson, Vice-President of the Wisconsin Bridge & Iron Co., Milwaukee, Wis., and the type of construction is very similar to that previously used by him for the supports of large ore bins at the stamp mills of the Ahmeek Mining Co., in Houghton County, Michigan. We are indebted to Mr. Jackson for information concerning this interesting ore dock.

The railway company had at Marquette a timber ore dock of ordinary construction which had been in service about 16 years, and in 1910 it became necessary to consider its replacement. The scarcity and increased cost of suitable timber, and the expense of maintenance and operation of the timber dock, led to an investigation of the relative costs of different forms of construction. Estimates showed that taking the first cost of a timber dock at 100%, that of a reinforced-concrete dock would be about 167% and that of a steel dock, 185%. Excluding the relative cost of operation, and including maintenace over a term of years, the cost on a long-term basis was found to be very much less for the reinforced-concrete dock than for either of the other types. Late in 1910, plans were prepared and the contracts for the structural steel and machinery were let on a percentage basis. A fee for engineering services was a separate consideration.

The new dock is 1200 ft. long (with 100 pockets on each side), 75 ft. high from water level to base of rails, and 54 ft. wide on the deck, which carries four lines of rails. The 200 ore pockets have each a capacity of 250 to 300 tons. There is an approach fill a mile in length about 600,000 cu.yd., on a grade of 1.5%; also an approach trestle 600 ft. long, and a tail trestle 60 ft. long, the latter extending beyond the end pockets of the dock proper. The completed dock is shown in Fig. 1, and the general cross-section, elevation and other details of construction are shown in Figs. 2 and 3. The dock has been in use for some months. It is located a little distance from the old timber ore dock.

Substructure

The entire area for the pier is inclosed with sheet-piling, composed of 12x12-in. Oregon fir timbers with 4x4-in. hardwood strips nailed on two sides to form a dovetailed tongue and groove, respectively. Inside and outside waling timbers are used, and the lines of sheeting are connected at intervals of 3 ft. by 1¼-in. tie-rods extending through the wales. Nearly 10,000 timber piles (30 to 45 ft. long) were then driven, having a penetration of about 20 ft. in the sandy bed of the lake. This work was done mainly by land pile-drivers (using steam pile-hammers) which traveled on tracks built on piles. A water-jet was used to assist the driving. The pile heads were cut off approximately at the water level by a railway pile-driver traveling on a track laid upon the piles. This had a revolving platform, and in the leads was fitted the vertical shaft of a 42-in. circular saw.

The space inclosed by the sheet-piling was then filled with dredged sand, after which a concrete slab deck was built, in the bottom of which are embedded the tie-rods of the sheeting. The slip on each side of the dock is dredged to a depth of about 24 ft. The concrete slab is a monolithic block 60 ft. wide and 3 ft. thick, with a 9-ft. parapet wall on each side and with footings for the superstructure columns. It is reinforced longitudinally and transversely by old wire-rope hoisting cables, 1 to 1½ in. diameter, in long lengths. This was obtained

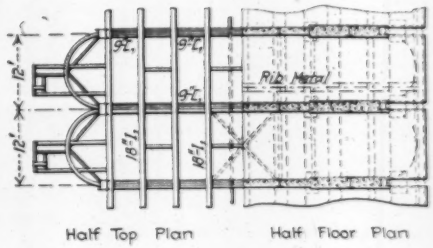

Fig. 3. Top Plan of Ore Dock

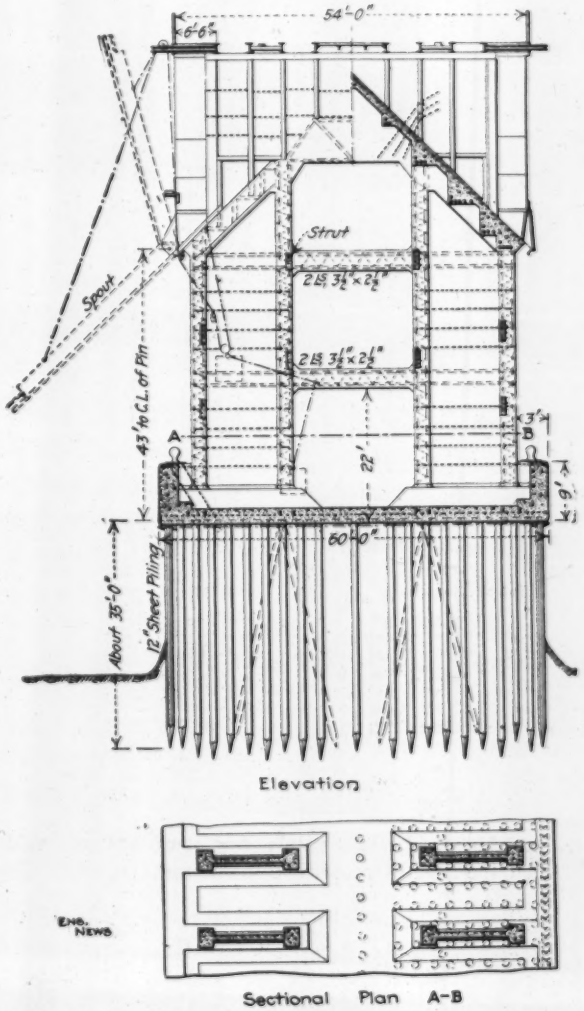

Fig. 2. Cross-Section and Bottom Plan of Reinforced-Concrete Ore Dock

from mines in the neighborhood at scrap prices. The total length of the slab is over 1500 ft. and in the 1200 ft. of the dock there are no expansion joints, although such joints are placed at each end, where the dock proper connects with the approach trestle and tail trestle. The

concrete (1:3:5) was deposited in place by revolving dump cars operated by cable on tracks of 2-ft. gage.

The whole foundation is very rigid, and no cracks of consequence have developed. The construction is so rigid and massive that the substructure is capable of withstanding very heavy bumps from large ships, and in the superstructure there is practically no vibration even when brakes are suddenly applied on the ore trains. An interesting feature of the dock-wall is the use of a steel facing-plate extending from the bottom of the concrete (6 in. below the water) to a height of 3 ft. above low water. This is intended to prevent the disintegration of concrete from freezing and abrasion by ice, at the water line, and government breakwaters in

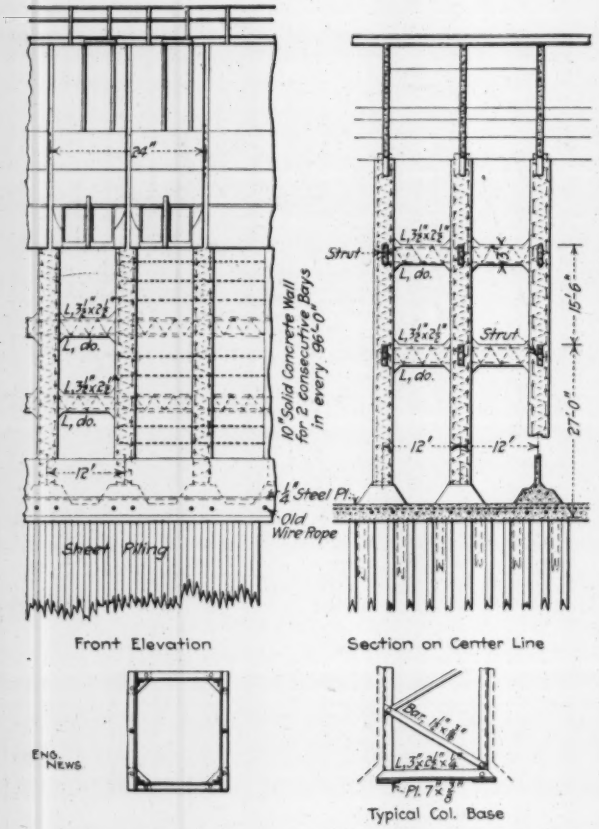

FIG. 4. PART ELEVATION AND LONGITUDINAL SECTION

the neighborhood, built only a few years ago, are said to show the need of protection of this sort.

SUPERSTRUCTURE

The superstructure is of reinforced concrete with a concrete A-shaped floor for the pockets and concrete transverse partition walls between the pockets. The front wall of the pockets, however, is of steel; the front of each pocket is in semi-cylindrical form, which greatly reduces the liability of the ore to pack over the doorway, which is a trouble occurring in pockets having flat walls. After the completion of the substructure, the reinforcement of the columns, struts and partition walls of the pockets was erected, forming a self-supporting steel structure, as already noted. The semi-cylindrical front walls of the pockets and some other parts of the steelwork, were erected later.

There are four rows of columns, spaced as shown on the drawings, and connected by horizontal lines of longitudinal and transverse struts. The main columns of each bent are 28x36 in. section, and are connected in pairs by transverse 12-in. curtain walls. In certain panels, also, there are longitudinal curtain walls between the columns, forming towers which add to the longitudinal rigidity of the structure. Each column is reinforced by four angles 2½x2½x2¼ in., box laced. The columns and wall, which also carries load, were really figured as plain concrete carrying between 400 and 500 lb. per sq. in. The slight reinforcement shown was put in to prevent cracking and to form a positive means of tying the whole structure together both laterally and longitudinally. The general features of the work are shown by Figs. 2 and 3. The concrete bottom of the pockets forms a floor and is formed integrally with the longitudinal girders between the bents.

The complete self-supporting steel-skeleton structure formed by the reinforcement was erected complete (in advance of the concreting) by a traveler running on the concrete deck of the substructure and working back from the shore end. On this were two hoisting booms. The balance of the work was erected by a derrick-car on the overhead tracks. The steel angles had been punched with holes 4 ft. apart, to carry plugs which projected 2 in. from the steel and served as spacing blocks against which the forms were secured. This provided for ready and accurate placing of the forms, and insured a 2-in. thickness of concrete outside of the steel. All the form work was of wood. The forms were placed and the concrete poured in lifts of about 12 ft. The handling of the concrete and the design of the forms for use over again were large problems in themselves, and we are informed that in the design of a similar structure the concrete part would probably be modified in some respects to simplify the work.

Fig. 4. shows the concreting of the lower part and the steelwork of the pockets. Fig. 5 shows a partial elevation with the concreting completed. For about 100 ft. of the shore end, the concrete was handled in the cars mentioned in connection with the substructure work, the cars being hoisted by an elevator to the deck level and run to the desired point for dumping. After the concrete of this part of the dock had set, a traveling mixer plant was erected upon it, the front end of the traveler (with only a light load) being carried on a track supported by the steel reinforcing structure. The concrete (1:2:4) was discharged from the mixer into a chute carrying it to the forms.

DOORS, CHUTES AND OPERATING MACHINERY

Each pocket has two doors, 5 ft. wide and 3 ft. 8 in. high, emptying into the chute, as shown in Fig. 6. The chute is 35 ft. long, tapering in width from 8 ft. 6 in. at the upper end to 4 ft. 6 in. at the lower end, with a curved bottom throughout the whole length. Many ore chutes have been built with flat bottoms and straight sides, or with bends in the sides which caused the ore to stick or to flow over the sides. This chute was designed on the theory that soft iron ores flowing with

some velocity would act much the same as a stream of water, and the results in service seem to confirm this view. When both doors are open, the ore flows in the chute about a foot in depth, apparently faster in the center and with increasing velocity toward the end of the chute, and the ores do not stick or clog, and do not overflow the sides. The practical effect of this easy flow through the chute is to enable the operator to run ore to the far side of vessels 60 ft. or more in width,

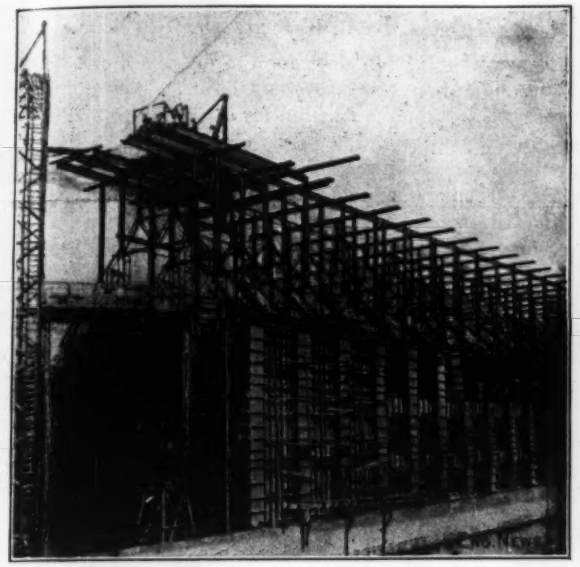

FIG. 5. CONCRETING THE SELF-SUPPORTING STEEL REINFORCEMENT OF ORE DOCK

and to trim the load perfectly. At many of the old docks an army of men is required to assist in their operation, because the ore does not flow freely from the pockets, but must be poked and "poled" to release it. Owing to the absence of sharp angles in the pockets, and the location and width of the doors, there is little of this work to be done in the new dock.

The design of the chutes themselves and of their operating machinery differs materially from designs previously used. It is believed that this is the first instance in which the chute winding cable, drums, counterweight cable and swinging counterweight are laid out in such a way that the chute (which weighs 8200 lb.) is perfectly balanced in every position. The hoists of each set of six adjacent chutes are operated through friction clutches from a 2-in. line shaft driven by a 15-hp. motor, and two or more hoists on one line shaft may be operated together. The time required to raise or lower a chute is only 20 sec. To move the chute, the operator must first relase and hold the automatic brake with the left hand, then hold the lever of the friction clutch in operating position with the right hand. The machinery is simple and reasonably fool-proof, and all moving parts are protected by safety coverings.

CONSTRUCTION AND OPERATION

Mr. Jackson and the engineers of the Wisconsin Bridge & Iron Co. were chiefly responsible for the superstructure, and the steelwork and machinery were built and erected by this company. The chutes were built under the Carter patents, and a number of patent claims have been allowed in certain features of the superstructure. The substructure was designed by R. C. Young, Chief Engineer of the Lake Superior & Ishpeming R.R. The railway company also furnished certain materials and did some parts of the work, including the large approach fill or embankment. The pile-driving and concrete work were done by the Raymond Concrete Pile Co. The dredging was done by the Zenith Dredge Co., a large part of the material being moved with a hydraulic dredge and deposited to fill swampy ground and to form the base of the approach embankment.

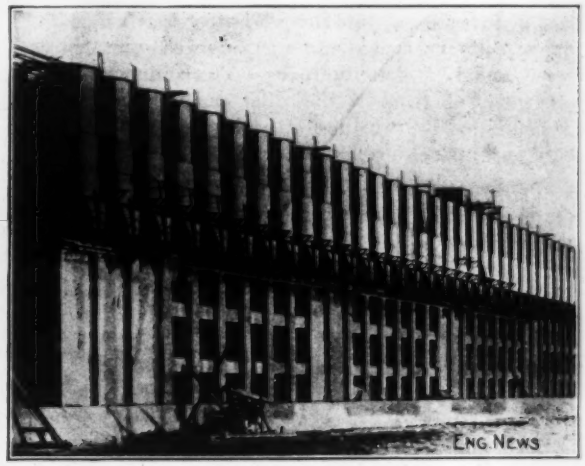

FIG. 6. PART ELEVATION OF ORE DOCK, SHOWING REINFORCED-CONCRETE BASE AND STEEL FRONTS OF ORE POCKETS

As to the operating cost, detailed records are not yet available, but we are informed that Mr. Young reports that it is probably only 25% to 33% of the operating cost for the old timber dock. Only a small amount of steelwork is exposed, so as to require painting, and the maintenance and depreciation costs should be very low.

REINFORCED-CONCRETE ORE DOCK; GREAT NORTHERN RAILWAY

This dock (mentioned in the first part of the article) was built in 1911 at Superior, Wis. It is about 1900 ft. long, with a deck 62 ft. wide and 75 ft. above the water. An A-shaped floor extending from the center line to the

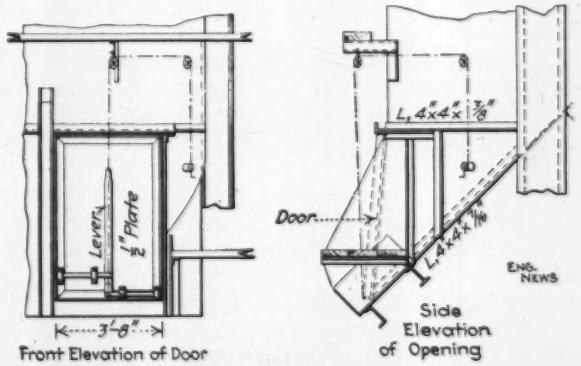

FIG. 7. DOOR OF ORE POCKETS

sides forms two longitudinal troughs which are divided by cross-walls so as to form 151 pockets on each side, in the usual arrangement. The pockets are 12 ft. long, each with a capacity of about 300 tons of ore. With its great length, six of the largest ore steamers can be loaded at one time.

The substructure consists of two lines of timber cribs (connected by crosstimbers), in each of which are driven seven rows of piles. Each line of cribbing is capped by a concrete slab 21 ft. wide and 3 to 8 ft. thick, upon which are the pedestals for the superstructure columns. These slabs are connected at intervals by transverse girders of reinforced concrete which support a filling or deck. Expansion joints with 2-in. filling are provided in these slabs at intervals of 120 ft. The superstructure has two rows of columns, spaced 44 ft. 7 in. between centers transversely and 12 ft. longitudinally. The columns extend to a height of 40 ft. above the water and those of each row are connected by two lines of horizontal struts, while in every tenth panel a concrete curtain wall is built between the columns, to give additional longitudinal rigidity. There is no transverse bracing between the columns.

In cross-section, the columns are 7 ft. by 2 ft. 9 in., reinforced only by a ⅞-in. square rod at each corner. Upon these columns is carried the steel framing of the partitions and front walls of the pockets, the partition framing being embedded in concrete walls. The track stringers of the deck and the I-beam purlins supporting the inclined floors of the bins are carried by the partition framing, so as to transmit all loads to the columns, there being no longitudinal girders between the columns. The inclined floor of the pockets is of creosoted fir timbers, with a wearing surface of 4-in. maple plank, both laid up and down the slopes, which has an angle of 47½°.

The face or outer wall of each pocket is of steel, semicircular in plan; this arrangement practically prevents the arching of the ore which sometimes occurs over the door openings of pockets having flat walls. These openings are 5 ft. wide and 31 in. high, fitted with sliding steel doors which are raised by hand winches. The doors cannot be closed against a stream of ore, so that each pocket must be allowed to empty itself completely. The spouts are 34 ft. long, and taper in width from 5½ ft. at the upper end to 4 ft. at the lower end. To a bail on the lower end is attached a 5-in. flat-wire rope led to a drum on the upper deck. The drum is operated from a line shaft by a friction clutch; this shaft is divided into sections, each serving ten drums and driven by a 25 h.p. motor. The power is sufficient to operate several spouts simultaneously. The spouts are raised and lowered by power, so that they are always under control.

Bin Door for Ore Pockets

By R. B. Pearson*

A new type of bin door for ore docks, etc., of which I am the inventor, is described below. This door was developed to supply a demand for a large door that could be handled easily and could be closed against a head of ore in the bin when it was desired to "split a pocket" (or discharge only part of the contents) in trimming ship.

The drawings, Figs. 1 to 4, illustrate the action of the door. Fig. 1 shows the door in its normal position.

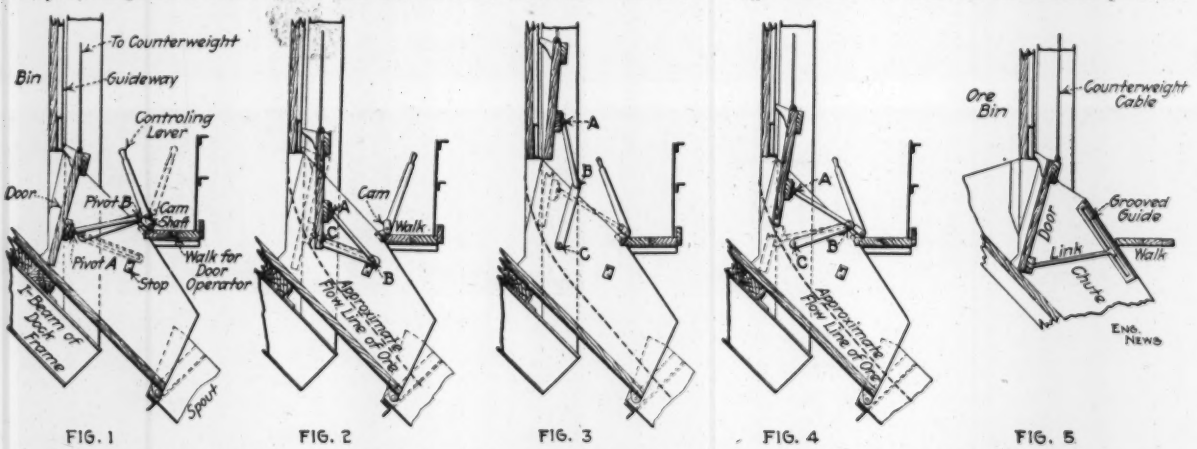

FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5

New Design of Bin-Door for Ore Docks. R. B. Pearson, Duluth, Minn., Inventor

(Fig. 1. Door closed and locked. Fig. 2. Door unlocked and forced open by flow of ore. Fig. 3. Door raised clear of opening. Fig. 4. Door closing and about to cut off the flow of ore. Fig. 5. Bin door on ore-dock No. 1 of the Duluth & Iron Range R.R., at Two Harbors, Minn.)

The door is guided at the top in a guideway attached to the bin, and the lower part of the door is free to swing, except as restricted by a simple link motion on each side. Each link motion consists of a strut and link pivoted together at one end, *B*, while the opposite end of the link is pivoted to the bin or side of chute, at *C*, and the opposite end of the strut is pivoted to the back of the door near one edge, at *A*.

The position or movement of the door can be controlled by shifting the pivot *B*, of the link motion. This is done by means of the cams or dogs on the cam shaft, which is supported by brackets on the side of the chute. When the door is closed and the pivot *B* is held well above the pivot *A* by the cam, the reaction resulting from the pressure of the ore against one side, and the strut against the other side of the door, will be downward and will hold the door closed. When it is desired to open the door, the cams are withdrawn from the path of the pivot *B* by means of the controlling lever, and this pivot then drops to the position shown by the dotted line in Fig. 1, so that it is well below pivot *A*, on the

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door. The reaction resulting from the pressure of ore, and the strut in this position, will be upward, tending to raise the door clear of the flow of ore to the position shown in Fig. 2.

From here it can be raised by hand to the full height of opening, as shown in Fig. 3, the door being counterbalanced for this purpose. As soon as the door is raised to this position, the cams are again set to hold pivot *B* in the position to lock the door shut. Then in closing it will only be necessary to lower the door by hand,

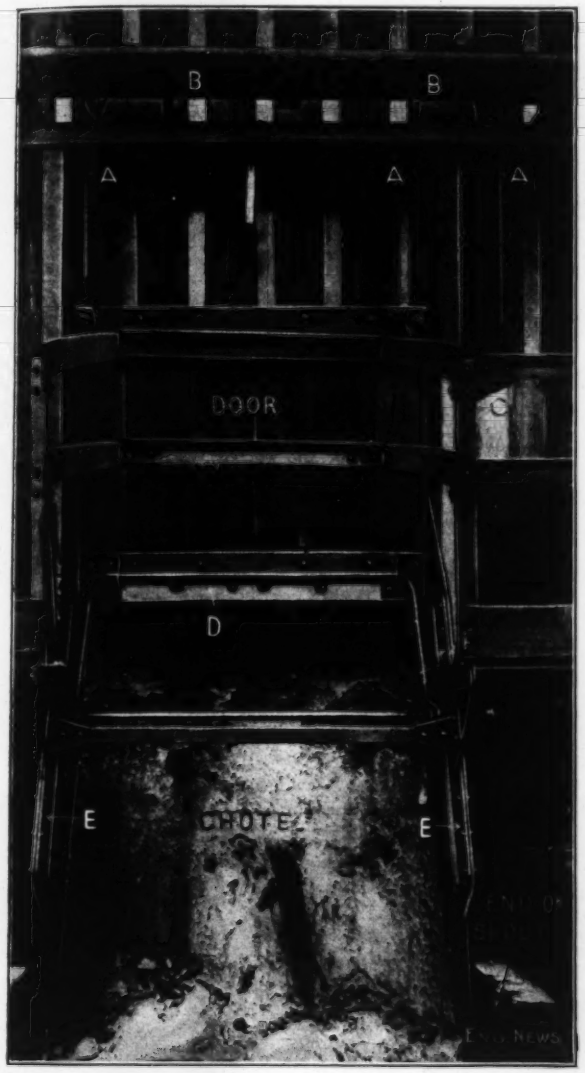

FIG. 6. BIN-DOOR ON ORE-DOCK NO. 1 OF THE DULUTH & IRON RANGE R.R.

pivot *B* following the arc of a circle until stopped by the cam as shown by the dotted line in Fig. 3. This position is shown more clearly in Fig. 4, and at about this point the lower edge of the door will enter any flow of ore in the chute. The resultant of the momentum of the ore and the thrust of the strut is then downward, forcing the door down through the ore to the closed position, the pivot *A* describing the arc of a circle about *B* as a center during this last portion of the door's travel. Should there be no flow of ore, the door, being counterbalanced, would be pushed all the way down by hand.

A modified form of this door has been placed on all pockets of the new dock No. 1 of the Duluth & Iron Range R.R. at Two Harbors, Minn., and gives good satisfaction in operation. In the form shown in the drawings (Figs. 1 to 4) I believe I have a much smoother acting door than that used by the D. & I. R. R.R. A detail of this latter door is covered by a patent recently issued to another person, which patent, however, has conceded priority to me (in interference) as to everything common to both patents.

[The patent granted to Mr. Pearson is No. 1,040,237, dated Oct. 1, 1912. The claim mentioned covers a "bin having an opening in one wall, a closure for said opening adapted for compound movement in a vertical and horizontal direction, a strut on said closure, and means associated with said strut adapted to control the path of travel of the free end thereof." In Figs. 5 and 6 we have shown the bin door of the ore dock of the Duluth & Iron Range R.R., from drawings and photographs sent us by Mr. Pearson. The door is hung in the same way, but instead of the jointed link previously described the link is a single piece; one end is pivoted to the bottom of the door, and the other end has a head sliding in grooved guides attached to the chute. The guide arrangement is covered by a patent granted to O. H. Dickerson, but it is claimed that this infringes the patent of Mr. Pearson, which is considered to cover the entire door action. The latter states that he has issued a restricted license to Mr. Dickerson for his modified form only. In Fig. 6, the counterweight cables *A*, attached to the door, pass over the pulleys *B* and are attached to the counterweight *C*. The bent bar *D* forms the link, with the ends of its two arms traveling in the inclined guides *E* on the sides of the chute. Descriptions of the Duluth & Iron Range R.R. ore-dock No. 1 and of other ore docks and ore-pocket doors are given in two separate articles elsewhere in this issue.—EDITOR.]

Steel Ore Dock: D. & I. R. R.R.

A large steel dock was built at Two Harbors, Minn., in 1911, by the Duluth & Iron Range R.R., to replace its timber dock No. 1 at that place. It is the second steel ore-dock built by this railway, the first one having been completed in 1908. The design for the new dock was made by W. A. Clark, Chief Engineer, and the construction is shown in Figs. 1 and 2. This dock is nearly 1400 ft. long, 74 ft. high from water level to rail level, and 52 ft. wide on the deck, which carries four tracks (two over each line of pockets). There are two rows of pockets, 112 in each row, with floors sloping from the center line (at the top) to the sides. The pockets are 12 ft. long, and about 35 ft. deep, separated by 12-in. concrete partition walls, and each pocket has a nominal capacity of 4150 cu.ft., or about 300 tons (or 67,200 tons in all). The substructure consists of two parallel reinforced-concrete slabs resting on rows of piles and connected by cross-girders. The entire space occupied by the dock is inclosed by an outer line of sheet-piling under the face of the concrete. Upon these slabs are the pedestals for the steel columns.

The superstructure has two lines of columns, spaced 37 ft. apart transversely, and 12 ft. longitudinally, with transverse bracing in each bent and longitudinal diagonal bracing between alternate pairs of bents. Each column is composed of an 18-in. I-beam (with web transfers to the center line of the dock), two 24-in. side plates riveted to the flanges, and four corner angles 4x4 in. on the edges of the plates. The columns support transverse A-frames of

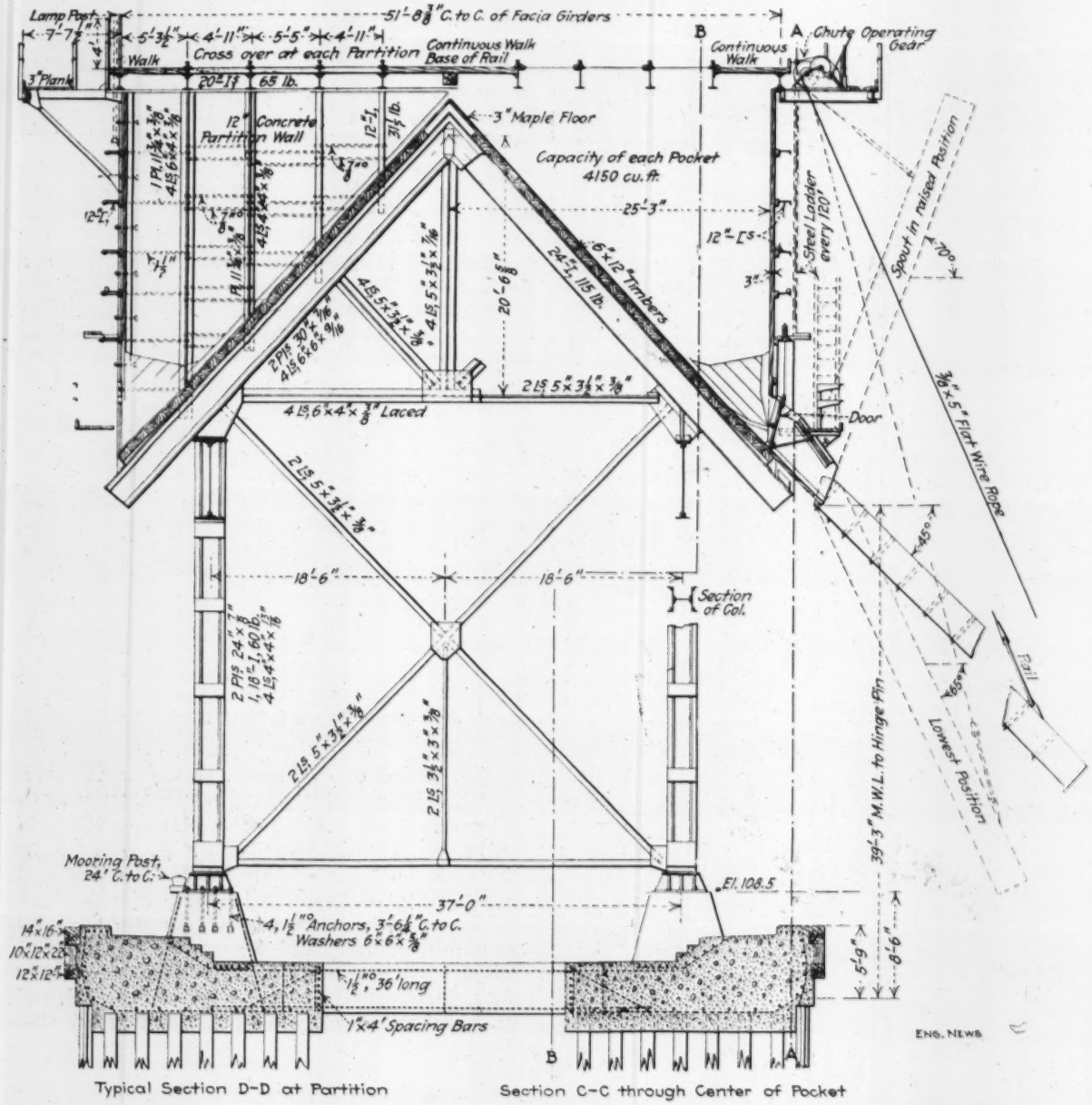

FIG. 1. CROSS-SECTION OF STEEL ORE-DOCK AT TWO HARBORS, MINN.; DULUTH & IRON RANGE R.R.

30-in. plate girders, and just below their tops are longitudinal 72-in. plate girders, framed between the webs of the columns. Between each pair of A-frames are two 24-in. I-beams (resting on the girders), and upon these and the A-frames are longitudinal lines of angles 4x4 in. Between these angles are longitudinal timbers 6x12 in. laid close together and forming the floor of the pockets. These

The A-frame girders carry vertical 12-in. I-beams which are connected by tie-rods and top angles, the entire vertical framing being embedded in the 12-in. concrete partition walls. On these walls rest lines of longitudinal 20-in. I-beams, upon the top of which are laid the track rails. The deck is carried by shelf-angles, on the webs of these I-beams. The floor of the pockets has a slope of

are covered with a wearing surface of 3-in. maple p laid up and down the slope. The outer walls of pockets are of 3x12-in. vertical plank spiked to tie bolted against longitudinal 12-in. channels attached t framing of the partitions. The dock extends 32 ft. bey the pockets, so that a locomotive can bring its first over the end pocket. The steelwork is painted with Illinois Steel Co's. graphite paint.

48° from the top to within 8 ft. of the doors, where it is reduced to 45°. Each pocket has a door opening 5 ft. wide and 3 ft. high. This is fitted with a vertically sliding door attached to a counterweight cable, which raises it when the latching lug is released. The top of the door moves in guides, but the lower end has a swinging motion controlled by a link having one end pivoted to the bottom of the door and the other end sliding in an inclined guide on the discharge chute. This arrangement facilitates the closing of the door against a stream of running ore. The door mechanism is covered in part by a patent of O. H. Dickerson, of Detroit.

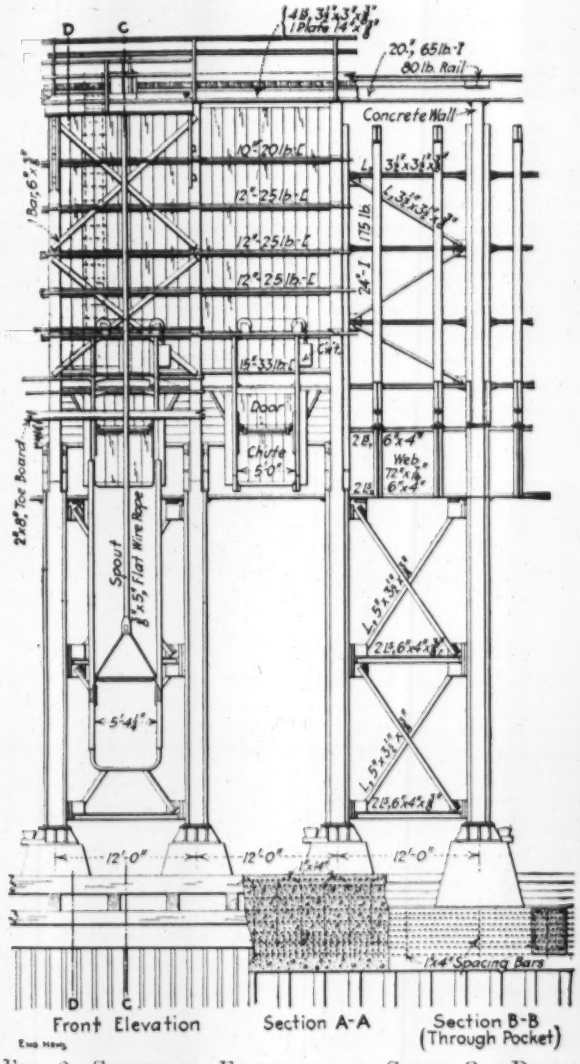

FIG. 2. SECTIONAL ELEVATION OF STEEL ORE-DOCK; DULUTH & IRON RANGE R.R.

The spout, hinged at the end of the discharge chute, is 34 ft. long, 5 ft. 4 in. wide, and 2 ft. 6 in. deep. At its outer end is a bail to which is attached a flat wire rope whose upper end is wound upon a drum operated from a shaft running along the top of the dock by means of a friction clutch. Each length of shaft carrying ten drums has its own electric motor, but only one spout is operated at one time. There is no counterweight to the spout. The substructure work was done by Whitney & Hill, of Superior, Wis., and the American Bridge Co. built and erected the superstructure.

COMPARISON OF STEEL, CONCRETE AND TIMBER FOR ORE-DOCKS

As to the relative economy of ore docks of steel (painted) and reinforced concrete, the officers of the Duluth & Iron Range R.R. believe that the comparison is favorable to the steel structure, the comparison presupposing two structures of equal strength and equally well fitted for the service. For the service required of these docks, rising 100 ft. above solid ground and subject to the strains due to moving trains, the dumping of ore and the impact of boats against the foundation, it is considered doubtful whether reinforced concrete is so suitable as the more elastic steel structure.

The life of a timber dock under modern conditions of service is limited to from 10 to 15 years, depending on the design, the severity of the service, and the amount which the owners are willing to spend for extraordinary repairs before rebuilding the entire structure. A life of 12 years is all that can ordinarily be figured safely for conditions on the D. & I. R. R.R. The life of the steel dock can, of course, only be estimated, but it is thought reasonable to believe it would not be less than 30 to 40 years. The modern steel dock can be constructed at a cost of $3800 to $4500 per pocket, exclusive of dredging, but including doors, spouts, hoisting machinery for the spouts, and electric lights. The cost varies considerably according to the design of these features and the local foundation conditions encountered, and it varies, of course, almost directly according to the capacity of the pocket. The cost of the timber dock under the same conditions will vary from $2400 to $3000 per pocket.

It is very difficult to compare the maintenance cost of the steel and timber docks because a large part of the maintenance is in connection with the doors, spouts,

FIG. 3. SHORE END OF STEEL ORE-DOCK AT TWO HARBORS, MINN.; DULUTH & IRON RANGE R.R.

hoists, and the lining of the floor bins, and these costs are not kept separate from the other repairs. Comparison is difficult also, because of the different conditions of service upon different docks, the tendency always being to ship a greater proportion of ore over the more modern docks, which thus carry a heavier service. However, the figures of the D. & I. R. R.R. for the past three seasons, seem to indicate results favorable to the steel docks.

Progress in Military Explosives*

By Wilford J. Hawkins†

SYNOPSIS—A quarter century ago, there occurred in United States a marked revival of interest in military and naval matters. During the score of years following the Civil War the Nation had neglected its army and allowed its navy to become obsolete. There was sudden awakening to the fact that the Nation was wholly without means of defending itself in case of attack by a foreign foe. The work of building a new navy and providing both army and navy with modern weapons was actively undertaken; and great interest was taken by the engineering profession in this work. In recent years, however, partly as a result of a policy of secrecy concerning military matters which came into force about the time of the Spanish-American War, the engineering profession has been little in touch with the progress in military engineering. The paper here reprinted gives a birdseye view of the progress which has been made along these lines during the past twenty years in powders, projectiles, fuses and primers.

Powders

In comparing our ordnance of 20 years ago with that of today, one is struck with the revolutionary character of the changes. In this country, at least, it would seem as though the year 1892 marked the beginning of a new order of development in war material. Prior to that date, for 30 years or more, the changes in such materials had been slight, except for the development of brown prismatic powder and the partial development of built-up rifled cannon.

The transition period in Europe had its inception four or five years earlier. The initial impetus seems in all countries to have dated from the first experiments with smokeless powders or with the development of the small-bore high-power small arm or both. The keys to the new development were furnished by Schönbein and Böttger when they discovered nitrocellulose, or gun cotton, in 1846; and by A. Nobel in 1888, when he brought out a colloidal powder, "cordite."

The French appear to have been the first to introduce new high power propellants into their service, using a BN powder composed of nitrocellulose and barium nitrate or possibly of other ingredients, inasmuch as their early efforts were shrouded in a good deal of mystery and accompanied by several changes due to unexpected difficulties experienced with their early powders of this type. These powders were first used in the Lebel small arm and were not by any means smokeless or otherwise ideal. Concurrently, Von Lenk was endeavoring to use gun cotton alone as a propellant by braiding it into cords or ropes and winding these tightly on a wooden core. Some success attended these efforts and Germany did some serious work in developing the idea, but it was inevitable that such a scheme should fail, due to the not infrequent occurrence of erratic burning of an explosive in such a finely divided form. Many other devices were resorted to, all having the common object of slowing gun cotton in order to make it suitable for a propellant. The theory of granulation was well known and had long been applied in connection with black powders; the sphero-hexagonal grains of black powder, the varying sized irregular grains and the perforated cocoa, or brown prismatic powder all bear witness to this. Gen. Rodman, as is well known, was the leader of thought in this line by many years. To him, no doubt, we owe the early development of the multi-perforated smokeless-powder grain, as he proposed such a granulation for charcoal powders, and this idea was resurrected coincident with the early development of smokeless powder in this country.

To go back a step to the efforts to force gun cotton to burn progressively, it is interesting to note some of the other expedients tried before a colloidal powder was finally evolved. In England, efforts were made to press up gun cotton into hard pellets with a matrix of india rubber. The use of small compressed cubes surrounded with paraffin was also tested. Simultaneously, the Italians were struggling along the same line with their Fossano powder, in which gun cotton was distributed through a less explosive substance used as a matrix. Schultz's pyroxylin sporting powder was the most successful of any powders of the non-colloidal type and is in use to this day. He made up a vegetable cellulose by the treatment of finely divided wood, which was subsequently nitrated, giving a vegetable nitrocellulose. To this he added potassium nitrate, barium nitrate, vegetable gelatin, and water. Brugere's powder, although not nitrocellulose, is worthy of note among the early efforts to produce a stronger propellant than charcoal powder. His consisted of a mixture of ammonium picrate and potassium nitrate. It gave good results, but was not smokeless or as satisfactory in other respects as the later colloidal powders.

Fig. 1. End View of Smokeless-Powder Grain Indicating Results of Brittleness

In 1888, A. Nobel pointed the way to the practical solution of the problem by making a colloidal powder, "cordite." This powder was composed of nitroglycerin, gun cotton, and vaseline. Soon after, colloidal powders of nitrocellulose alone were produced, using acetone as the solvent because of the high nitration of the gun cotton used at that time.

Thus, in our earliest experiments in 1892 with smoke-

*From a paper in the "Journal of the U. S. Artillery," September-October, 1912.

†Captain, Coast Artillery Corps, U. S. A.; Ordnance Department.

less powders, we, in the United States, found ourselves handicapped in being about four years or more behind the times as regards smokeless powder, and even more laggard as to high explosive for shell fillers.

The smokeless-powder problem was first attacked amid considerable difficulties. In the first place, scientific research along these lines had not been made in this country and no native was conversant with the subject. Furthermore, the great domestic powder plants had been built for the manufacture of charcoal powders, and their owners were not as enthusiastic in developing the new propellant as they might otherwise have been. Another difficulty lay in deciding among a nitroglycerin-nitrocellulose, a pure nitrocellulose, and a BN-type powder. Nothing definite was known of any of them at that time in this country. No tests had been developed to determine the degree of stability possessed. That they might be responsible for a high rate of bore erosion, was not known until a year later. Furthermore, the shape of the pressure curve was not known, and many of our own early built-up guns had been designed for chase pressures incident to black-powder propellants.

At this point it may be of interest to consider the array of artillery then in use by our service. It consisted of the 15-in. smooth-bore gun, the 8-in. converted rifle, the 37-mm. Hotchkiss light field gun, the 1.65-in. Hotchkiss mountain gun, the 3.2-in. field gun, the 8-in., 10-in. and 12-in. built-up steel rifles then in the type-testing stage. It included also the 12-in. cast-iron steel-hooped rifled mortar, and the 12-in. steel rifled mortar, both then without carriages other than the model of 1890 undergoing test.

However, in the face of this transition state of all our seacoast guns and carriages, samples of smokeless powders were obtained abroad and tested in 1892. One sample was of German manufacture and the other of the French or BN type. These were tested in the new 12-in. steel breechloading rifle with astonishing results, so far as the experience of this country was concerned. For the same muzzle velocity, the weight of German powder to that of brown prismatic powder was one to three. The corresponding ratio for the BN powder was one to two. Furthermore, the maximum chamber pressures with the smokeless powders were less than with the brown powder. The difference was so great that the new powders were suspected of being capable of detonative action and attempts were accordingly made to detonate them with mercuric fulminate, but without success.

In this year also, the 0.30-caliber Krag rifle was adopted for our service, and that led to parallel efforts to obtain a smokeless powder for the small arms cartridge. In fact, the development of satisfactory powder for that arm was depended upon to point the way for the selection of a smokeless powder for cannon.

To this end samples of Wetteren, Troisdorf, Maxim and Houghton smokeless small-arms powders were obtained and sent to Frankford Arsenal for test and examination. An ordnance officer of experience was specially detailed to the Frankford Arsenal to conduct tests with smokeless powders and to develop the chemical laboratory work involved. The early tests of smokeless powders as to stability were, as compared with present practice, extremely abbreviated. They consisted largely in exposing the powders to varying degrees of heat, to moisture, and to storage conditions in the assembled cartridge. The potassium-iodide test was known and applied—150° F. and 15 min. being, respectively, the minimum temperatures and time required.

In the ensuing year (1893) a number of samples of smokeless small-arms powder were received at Frankford Arsenal and tested—the Peyton, Leonard, du Pont, Axtell and Alters powders of domestic manufacture, and the Wetteren, Troisdorf, BNF, Swiss, Rifleite, S. R., and S. V. powders representing foreign manufacture. The Peyton powder was the only one of domestic manufacture worthy of note, and the standard of excellence was the Wetteren, with the Troisdorf also very highly esteemed.

Of smokeless powders for cannon, BN, German, U. S. Navy smokeless, Cordite, Troisdorf and Leonard powders were received and tested. The French BN powder was then in considerable favor as it contained no nitroglycerin, an ingredient even then much distrusted in this country. Firings with these powders were made in 12-in., 8-in., 5-in., 4.72-in., and 3.2-in. guns. Troisdorf, a nitrocellulose powder of German manufacture was also in considerable favor, as it gave uniform ballistics and was free from nitroglycerin. Cordite was not in favor, though it was known to have been adopted by England.

The subject of erosion in the bores of cannon first arose in this country at this time, and added another uncertainty to the already perplexing problem of selecting a suitable smokeless powder. It was thought that if erosion could not be avoided, the guns might be relined, an opinion which has since found expression in our practice.

The situation in 1894 was but little changed. Congress was insistent that a powder of domestic manufacture be adopted and every effort was made to stimulate the efforts of our own powder makers to produce a satisfactory powder. To this end, an ordnance officer was specially detailed at the works of the du Pont Company and provided with suitable ordnance at the works for testing the samples. The samples were slow of production as they had to be made up in small lots by hand in absence of any specially adapted machinery. Another officer was detailed on the Pacific coast to the Peyton company, and a proving ground produced at Benicia Arsenal.

In this year, the first ballistic specifications for smokeless cannon powders were drawn up:

Gun	Muzzle Velocity (ft. per sec.)	Maximum Chamber Pressure (lb. per sq. in.)
5-in. siege	1830 f.s.	31,360
7-in. siege	1085 f.s.	26,880
8-in steel rifle	2000 f.s.	33,600
10-in steel rifle	2025 f.s.	33,600

Various granulations were used, cord, strip, cube, and multiperforated. In the multiperforated, 19, 21 and 7 perforations were used.

In 1895 Peyton smokeless powder (nitroglycerin) began to be regularly used in loading 0.30-caliber small-arms cartridges, the service having been completely equipped with the new Krag rifles by May of that year.

In the two succeeding years experiments with cannon smokeless powders continued; and in 1897 the first smokeless powder was issued to our service for use in target practice with the 3.6-in. mortar. Contracts were also placed during this year with domestic firms for

Peyton, Rottweil, W. A., and nitroglycerin powders for 12-in. mortars, 10-in. and 8-in. guns. These contracts were divided among the California Powder Co., the American Ordinance, the Laflin & Rand and the du Pont companies. Also Peyton smokeless powder was definitely adopted and used throughout the year in loading 0.30-caliber small-arms cartridges for the Krag service magazine small arm. No further orders for charcoal powders were contemplated by the Chief of Ordnance.

As a sidelight on the status of artillery target practice in 1897, the following table of allowances published in a general order may be of interest.

Gun	Projectiles per Battery	Powder
3.2-inch field gun	18 Shrapnel 7 shell	IK
3.6-inch field mor.	7 shrapnel 8 shell	Smokeless
8-inch M.L.Conv'd Rifle	10 chilled shot Butler or Eureka	Hexagonal
8-inch | B.L. steel 10-inch | rifles 12-inch	3 shots each; 2 at 1725 and 1 at 2025 ft. per sec.	Brown Prismatic
12-inch B. L. mortar	3 shots	Black Moratr
10-inch S. B.	10 shots	Mammoth
15-inch S. B.	8 shots	Sphero-Hexagonal

(All shots at stationary targets.)

As germane to the subject of propellants, it may be stated that the Haskell multi-charge gun was tested at this time and found wanting; also that pneumatic guns were under test on the Pacific coast and that the Sims-Dudley dynamite guns were receiving consideration.

During 1898 and 1899 the situation as to smokeless powders continued about as before, the domestic manufacturers cited above being busy turning out their several types of smokeless powders in large quantities for the first time. A slight check to this work occurred in 1899 when all work of manufacturing smokeless powders was suspended on account of the destruction of an 8-in. and of a 10-in. rifle at Sandy Hook when smokeless powder manufactured in 1897 was being used. Upon investigation, however, confidence was again established in the smokeless powders under manufacture and the work resumed. The powder giving the destructive pressures was not of the type being manufactured and was found to have become brittle. This led to the present compression test of smokeless powders.

During the war of 1898, considerable newspaper agitation occurred on the subject of our defenseless condition as to a supply of smokeless powder; but this quieted down when it became known that all of our powder plants were doing their best to overcome the shortage.

The general trend of opinion was turning, during these years, toward the ultimate adoption of a pure nitrocellulose powder until, in 1900, that type was definitely decided upon for cannon. At this time, the rapid erosion of English guns under their "cordite" powder had become generally known, and that knowledge weighed heavily in making the above decision.

In 1900 sufficient confidence in our ability to make good common smokeless powder had been gained to warrant the placing of large additional orders with domestic manufacturers; but still the service had no smokeless powder except that for the 3.6-in. field mortar. In the ensuing year (1901), however, smokeless powder was also issued for the 3-in. 15-lb. D. S. gun; and, incidentally, it is interesting to note that moving targets were first used in our target practice that year.

To increase our knowledge of smokeless powders and of other ordnance material, two ordnance officers were sent to Europe in 1901 to investigate those subjects. Their visit had valuable results in many lines of ordnance work. New stability tests for smokeless powder were soon after put in use, so that by the end of 1901 the following tests were used additional to the potassium iodide test: Vieille 110° test (discarded later), Wills' explosion test (discarded later), Troisdorf or German 135° test.

About this time also arose the suspicion that certain substances if present in the powder might mask the standard stability tests and thus render them useless. This matter was investigated and the use of certain ingredients forbidden.

It was in 1901 that we first demonstrated in this country the danger attendant upon the use of smokeless powder for saluting or blank-charge purposes, the demonstration consisting in the entirely unexpected destruction of a 3-in. 15-lb. D. S. gun. It was later learned that similar experiences had occurred abroad.

The great length of time requisite for the drying of smokeless powder, especially of the larger granulations, having been brought forcibly to the attention of the Ordnance Department, various schemes to expedite the process were suggested. The expedient of drying in hot water for the removal of solvents and later drying in air, was tested and discarded as the stability and ballistics obtained under this process were unsatisfactory.

The study of smokeless powder continued during the succeeding year and resulted in the addition of the 115° Ordnance Department test; also in the discovery of certain basic laws relating to nitrocellulose and to the colloid made therefrom; as for instance (1) that after a certain point smokeless powder deteriorates more rapidly when hermetically sealed than when in the open air, (2) that finshed powder is not as stable as the nitrocellulose from which it is made; etc.

Consideration was also given to the subject of strip or tubular powders instead of the multiperforated grains in order to make the powder charge more wieldy and less apt to clog the breech box in inserting. A serious objection to long tubular powders for such fagoting was found to lie in the intense blow-pipe action of the combustion gases emitted from the bores of the tubular powder. Strip powders were unsatisfactory, due to lack of progressivity.

By 1903, the manufacture of smokeless powder was fairly well understood and the manufacture of it progressed with greater confidence. That the resident inspectors (ordnance officers) were removed from station immediately at the works was due to this increased confidence, although the necessity for their relief was due to the scarcity of ordnance officers for other pressing work.

The cause of the development of critical pressures in the case of several powders of older manufacture was further investigated and, as a result, the powder specifications were changed so as to include a compression test and thus require a tough powder free from brittleness. The critical pressures occurred between 38,000 and 40,000 lb. per sq.in. The action at this point was such that for a very slight increase in the charge, a very great increase in the maximum chamber pressure would result. It was found that acetone as a colloiding agent was in some measure responsible for brittleness in the finished powder.

Although nitrocellulose powder had now been definitely decided upon for cannon, nitroglycerin powder was still used for the small arm propellant inasmuch as its keeping

qualities seemed to be much better, and inasmuch as it did not give excessive erosion when used with the 220-grain blunt-nosed bullet and the finally adopted muzzle velocity. This powder, therefore, continued to be used until the advent of the 150-grain sharp-pointed bullet in 1906.

This year (1903) all artillery practice was, for the first time, had with smokeless powder. In the following year (1904) the quality of brittleness was further investigated and many ballistic tests made in this connection. It was found that good nitrocellulose powder when heated continuously at 150° to 180° F. gave increased pressures and velocities up to a certain time, and that thereafter these qualities decreased. The reason for this phenomenon was not discovered, but it is, after all, a safe characteristic.

Some little discussion was also indulged in as to the danger of ether and air mixtures in service magazines. In certain proportions, the mixture was found to be explosive, but its presence was rendered unlikely by an improvement in the hermetic seal of the powder-storage cases.

In 1905, the specifications for the manufacture of nitrocellulose cannon powder were further improved. The stability tests were increased in severity and greater care in the purification of the gun cotton was required. The hygroscopicity of nitrocellulose smokeless powders was also investigated. It was at first believed that increased moisture in smokeless powder resided only on its surface as a condensation, but this was later disproved. If this theory had been correct, the increase in moisture for various granulations must have been proportional to their surface areas; whereas, experiment showed that increases in moisture in all granulations, large and small, approached a common maximum lying between 2½ and 3%.

The Joint Army and Navy Powder Board was first convened in 1906 for the purpose of further improving smokeless-powder specifications. This Board soon adopted the same specifications for both Army and Navy powders and made some minor improvements in the specifications adopted.

The serious accidents which occurred in the Navy due to flarebacks brought up this subject for serious consideration in regard to the seacoast artillery. Tests were made but it was soon demonstrated that, for guns mounted in open air, such phenomena would not occur. That combustible gases are present, however, was clearly shown by holding a lighted match at the mouth of a cartridge case extracted from a gun immediately after firing.

The adoption of the model of 1906 small-arms cartridge with its light pointed bullet led to difficulties with erosion in the 1903-model service rifle; and the greater part of the years 1906 and 1907 was spent in trying to meet this difficulty, more than 100 samples of powders being tested. The adoption of the present pyro, or nitocellulose powder finally resulted, thus terminating the history of nitroglycerin powders in our service. The new small-arms pyro powder gave very excellent results so that the accuracy life was increased from less than 1000 to more than 10,000 shots.

The Joint Army and Navy Powder Board continued its labors and the Army and Navy powder specifications were made identical. The influence of aldehyde in alcohol had always been much feared and the specifications had always prohibited its presence in the alcohol even in the minutest quantities. Upon investigation, however, it transpired that this substance, even if present in the alcohol to the extent of 5%, caused no decrease in the stability of the finished powder.

The great lengths of time required for the drying of smokeless powder, especially of the larger granulations, still engaged the attention of the authorities and quick drying powders were considered and tested, but with indecisive results.

During this year, the coast artillery service first received authority to reblend and weigh smokeless-powder charges for service practice, and thus arose the interesting discussions between the "blenders" and the "anti-blenders." Whatever may have been the ballistic result of blending, it is certain that it was justified by the awakening of increased interest in the Coast Artillery.

The Joint Army and Navy Powder Board was active in 1909 in still further improving the smokeless-powder specifications, especially as to the granulations best suited to the several service guns and mortars involved. Efforts were made to reduce the maximum pressures and thus to permit an increase in the muzzle velocity. The subject of bore fouling was also considered, with a view to reducing the amount and hardness of the deposit. In this year, the Army Powder Factory at Picatinny, N. J., was completed and the work of installing a small experimental plant for the manufacture of high explosives inaugurated.

In the three succeeding years, up to 1912, the situation in this country as to smokeless powder has remained practically *in statu quo*, except for minor improvements. These have consisted in changes looking toward the further stabilization of the powder, the cheapening of the product, and the acceleration of the methods of manufacture, especially as regards the matter of drying. The Army Powder Factory at Picatinny has proved a most useful adjunct in the improvement and cheapening of smokeless powder, furnishing as it does a large laboratory, so to speak, in which the Army may try out under ideal conditions the various expedients suggested from time to time. To this factory is due credit for having developed a powder for the 12-in. mortar applicable to all zones, a boon for which the Coast Artillery has reason to be thankful. To it also is due credit for having demonstrated what the cost of smokeless powder really is.

In 1911 our smokeless powder was attacked in the foreign press on the ground that it could not be safely fired when heated as high as 150° F., due to the multiperforated type of grain and the composition. This gage was promptly taken up and firings made with the powder preheated to 208° F., with no excessive pressures not accounted for by the usual temperature compensation.

The small-arms powder (pyro) has been further improved so that the accuracy life of the 1903 model service rifle approximates 15,000 shots. The addition of a new ingredient has resulted in decreasing the bore fouling and increasing the accuracy. In the last annual competition, held under the auspices of the National Board for the Promotion of Rifle Practice, for the selection of ammunition for the national match, the government-made ammunition took second place, losing first place by a margin of a small fraction of an inch on the mean radii.

To sum up, it appears that we started in on the development of a suitable smokeless powder in 1892, four or five years behind our European competitors, and by 1903 had

produced and issued a fairly satisfactory powder. From that date untill 1912 the work has been in the nature of minor improvement until at this writing our powder seems to have reached a degree of perfection scarcely excelled by that of any other nation. This is particularly true of all our powders manufactured subsequent to 1907. Striking evidence of this has been given by the destruction of the "Aquidaban" (cordite), the "Jena" (inferior nitrocellulose), the "Mikasa" (cordite), and the "Liberte" (inferior nitrocellulose). Two other explosions caused by the spontaneous decomposition of cordite have occurred, which happily were localized and did not destroy the ships—on H.M.S. "Revenge" and "Fox." Recent investigation of the French nitrocellolose powder indicates that inexcusable carelessness prevailed in that country in the manufacture, storage, and reworking of their powders. In Germany, it is understood that nitrocellulose is used in the army, except for howitzers, but that a nitroglycerin powder specially stabilized (other than by mineral jelly) is in use in the navy. Russia uses a nitrocellulose powder while Italy and Spain use nitroglycerin powders, "ballistite."

We believe that nitrocellulose is superior to cordite or nitroglycerin powder for several reasons. (1) Nitrocellulose of a lower nitration is used and this permits of better purification and gives a more stable cellulose. (2) Nitrocellulose is insensible to ordinary shock at all temperatures, whereas at moderately high temperatures "cordite" exudes nitroglycerin and becomes sensitive to shock. (3) With the stabilizers now in use, our nitrocellulose powder may be expected to withstand a storage of 20 years as against our experience of 10 years or less for "cordite." (4) The temperature of explosion of our nitrocellulose powder is about 50% less than the corresponding temperature for "cordite." Consequently gun erosion progresses much less rapidly with our nitrocellulose powder. (5) The chemical decomposition of our nitrocellulose powder in storage is at all times gradual and does not reach a critical stage beyond which the rate of decomposition is greatly accelerated and terminated by explosion. "Cordite," on the other hand, is treacherous in this respect, giving good stability tests perhaps for a number of years and then suddenly decomposing in a few months to a dangerous condition, usually terminating in explosion.

England has evidently realized some of the disadvantages of "cordite" in recent years as is evidenced by the change from "Mark I Cordite," containing 58% nitroglycerin, to "Cordite M. D.," containing but 30%.

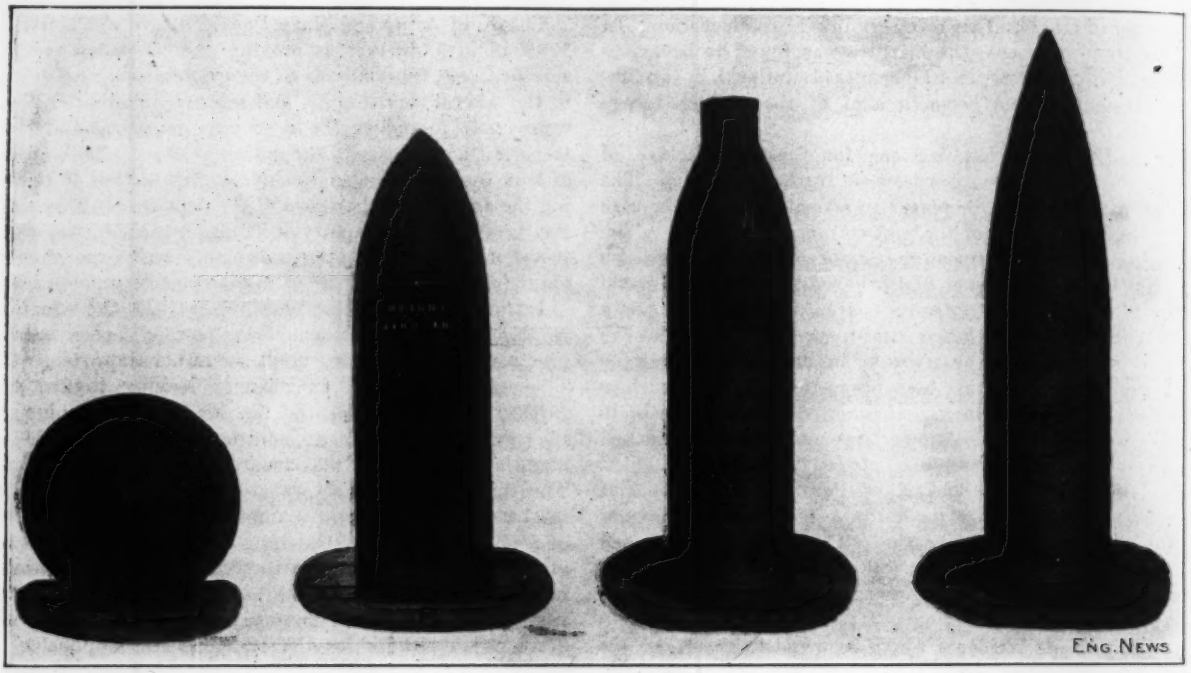

FIG. 2. EVOLUTION OF U. S. ARTILLERY PROJECTILE IN EXTERIOR FORM
(A, 20-in. spherical; B, 16-in. ogival; C, 12-in. ogival shell with early cap; D, modern 12-in. shell with long-pointed cap)

If it were not for the fact that a change from nitroglycerin to nitrocellulose powder entails an immense pecuniary expenditure in guns, magazines, ammunition hoists and the like, it is not improbable that many countries now using nitroglycerin powder would change to a nitrocellulose of low nitration like our own.

PROJECTILES

Twenty years of progress in the manufacture of steel projectiles in this country covers very nearly the entire subject. The first attempts in the manufacture of forged-steel shell in this country seem to have been made by the Midvale Steel Co. in 1885 in connection with early experiments to determine the best material for 8-in. seacoast shell. These were used in connection with tests of high-explosive shell fillers such as nitrogelatin. The earliest orders for service steel projectiles of 8-in., 10-in. and 12-in. calibers were placed in the early nineties and were small. They were mostly placed with the Midvale Steel

Co., yet with that company in the first year under our consideration we find but one small order for 12-in. mortar shells.

In these early times, special alloy steels and the treatment of such steels was, in this country, an unopened subject. Also at this time high-explosive shell fillers in this country were primitive in the extreme. Various attempts had been made to use dynamite, nitroglycerin and nitrogelatin with but indifferent success, and with the not infrequent destruction of the guns used in the tests.

The Winslow high-explosive shell is perhaps the most ingenious device of this sort tested. In it, the ingredients necessary for the production of nitroglycerin were inclosed in separate glass bottles, and there was provided a firing pin protruding to the rear through the base of the projectile so that it would be forced into the shell and break the glass bottles upon the explosion of the propelling charge. It was supposed that nitroglycerin would be formed during the flight of the projectile. A time fuse of the old plug type was used. It was found that these projectiles seldom exploded and that when they did it was with a low order.

Various other high-explosive projectiles were tested. Garrick's nitroglycerin shell appeared in 1885 as a forerunner of the Isham shell of later years. The Ordnance Department also tested a shell of this type, but desisted after the destruction of a gun.

being tested abroad for this purpose prior to 1895 and found as satisfactory as picric acid. The nitro-cresols were also tested abroad, the "ecrasite" use by the Austrians being of this class and bearing the same chemical relation to cresol that picric acid bears to pheñol. In France prior to 1886 various mixtures of picric acid and oxygen carriers were used as shell fillers under the name of "melinite." But following Turpin's patent picric acid alone was used under the old name. In England also pricric acid was used under the name of "lyddite," so named because the experiments with it had taken place near Lydd.

It was soon found that picric acid alone was unsatisfactory, due to its tendency to form sensitive metallic picrates; so thereafter recourse was had to its chemically less active salts, such as potassium picrate and ammonium picrate.

Having described the general situation at the beginning of the period 1892-1912, we may trace the progress in that period. One of the early orders for seacoast steel shell was placed with the Midvale Steel Co. in 1892 and that company seems to have been remarkably successful in the manufacture of armor-piercing projectiles. In the following year, other orders for large-caliber steel shell were given the same company under specifications requiring the use of the Holzer process.

In 1896, "emmensite" was tested as a shell filler with

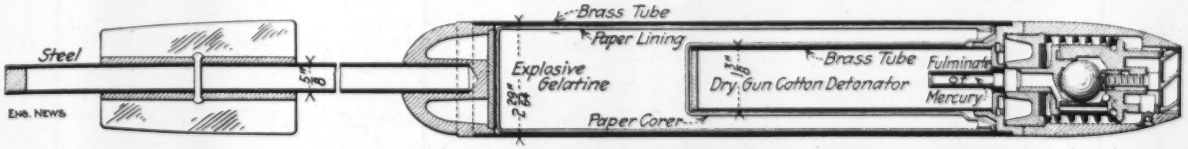

FIG. 3. THE SIMS-DUDLEY DYNAMITE SHELL OF 1899

The controlling idea, at that time, seemed to be to convey the largest possible quantity of the highest possible explosive to the target in the lightest possible envelope. The benefits to be derived from confinement in a strong envelope to develop the full force of the explosive, or the possibility of obtaining penetration and a delayed detonation, seem not to have been considered. Neither was attention given to providing a sufficient quantity of metal in the envelope to provide an ample number of effective fragments delivered at the highest attainable velocity by virtue of strongly confining the detonation.

It is interesting to note that it was only shortly prior to 1892 that the Butler obturating sabot gave place to the copper rotating band placed above the base of the shell as we know it today.

In Europe the matter of shell fillers seems to have been better understood. In 1885 E. Turpin, an Englishman, patented the use of picric acid as a shell filler, Sprengel having shown in 1883 that this material could be detonated. The salts of picric acid had also been proposed for use in powders as early as 1869 by Designolle, Brugere and Abel. Designolle's powder, consisting of potassium picrate, potassium nitrate, and charcoal, was for some time used by the French as a shell filler. In the same year (1869) Brugere and Abel simultaneously recommended a mixture of ammonium picrate and potassium nitrate. Later on, all of the picrates were investigated as to their suitability as shell fillers, ammonium picrate fairly satisfactory results. This explosive was of the picric-acid type with an addition of potassium or ammonium nitrate. Its stability was not considered satisfactory. At this time and until 1897 the subject of high explosives was handled by the Board of Ordnance and Fortification under the well known authority, Gen. Abbot. Experiments followed, in 1899, with the Gathmann projectile, with the Isham projectile carrying nitroglycerin, with the Sims-Dudley dynamite shell, with "joveite," and with Tuttle's "thorite."

The Gathmann wet-guncotton shell was a failure, as was also the Isham shell, as it provided only for an outside explosion. "Thorite" was rather favorably considered for a time, on account of its safety and insensitiveness; but it was nearly impossible to completely detonate it and it was decidedly hygroscopic. "Joveite" was a complex mechanical mixture of carbonaceous matter, picric acid, ammonium nitrate, sodium nitrate, and sodium oxalate. It was not favorably considered for obvious reasons. "Thorite" was not so complex, being a mixture of paraffin, a hydrocarbon, and ammonium nitrate.

In the following three years (1900, 1901 and 1902) experiments continued with the Isham shell until it blew up a gun at the Sandy Hook Proving Ground.

About this time explosive "D" made its appearance, as did also Hudson Maxim's "maximite." Explosive "D" was adopted for service, and "maximite," picric acid, "rend rock No. 400," and "thorite" were favorably con-

sidered for service use. "Maximite" was a mixture of mono-nitro-naphthalene and picric acid, which is apparently a recrudescence of Street's nitro-picro-naphthalene patented abroad in 1897. Later experience with "maximite" showed that it was not sufficiently insensitive to uniformly withstand setback in the field gun, so it was discarded. "Thorite" was used to some extent in field shell during the Spanish War and gave fair results. Picric acid has also been used as a shell filler to some small extent, but its tendency to form sensitive metallic picrates has caused its discontinuance for that purpose.

As explosive "D" possessed nearly all of the properties of an ideal shell filler, it was definitely adopted as the standard high explosive for this purpose, and has given satisfaction.

During the past few years trinitrotoluol has come into prominence abroad as a shell filler. It has also been tested in this country with promising results. Its striking advantages are its cheapness, chemical stability, or inertia, and its certainty of detonation, combined with a high degree of insensitiveness to shock. It is very similar structurally to picric acid, or trinitrophenol, and to trinitrocresol. All three of these substances are more or less suitable for shell fillers.

In 1904 C. M. Wheaton proposed his shell filled with an anæsthetic. It was also in 1904 that tests were made

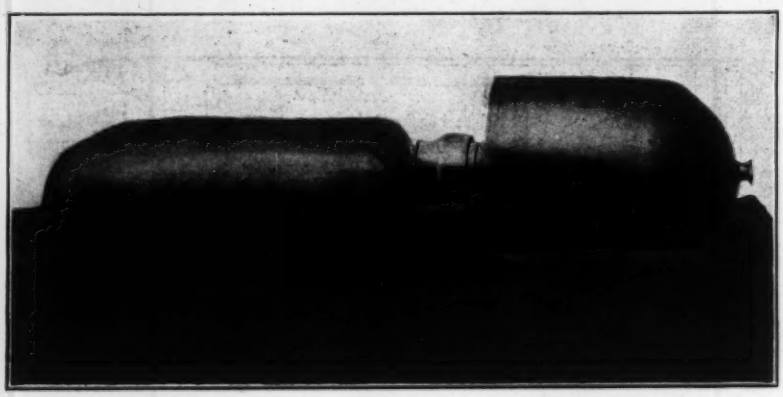

FIG. 4. THE GATHMANN GUN COTTON SHELL OF 1899

with armor-piercing projectiles with caps and without. The capped projectiles were found much superior as to penetration, and they bit as well on oblique impact as did uncapped shell. The cap was therefore adopted, and capped cast-iron projectiles were issued for coast-artillery target practice in 1906, the old projectiles having been redesigned, and a cap attached by means of a threaded tenon.

Following the adoption of the sharp-pointed small-arm bullet in the 1906 model cartridge, experiments were made with sharp-pointed cannon projectiles of similar form, and it was found that as much as 40% additional range resulted from the use of this form for the same muzzle velocity. Accordingly, a change to this form of projectile is in progress.

The standard projectile has also been further modified by the use of wide, continuous rotating bands. Bands up to one-third of the caliber in width were found to materially increase the accuracy life of cannon, offsetting the results of erosion, and have been adopted. Tracers for night firing have likewise been added in late years, but this device has not yet been fully developed.

Little has been said on the subject under discussion from the steel maker's point of view for the reason that the manufacturers give out no information as to their several methods. It is believed, however, that most armor-piercing shells are made of alloy steel carrying nickel, chromium, or tungsten. This steel is, of course, heat-treated with a view to obtaining great physical strength combined with toughness. Roughly speaking, such heat-treatment usually consists in heating to a point above the absorption point of the steel and of quenching in oil. Subsequently the steel is heated again to a lower degree than before, the exact degree depending upon the compromise between physical strength and ductility decided upon by the steel maker.

To sum up, our progress in 20 years of projectile manufacture has been greatly to increase the ability to penetrate, to develop a first-class shell filler, to add wide continuous bands, to add armor-piercing caps, and to sharpen the point so as to materially decrease the value of the coefficient of form.

FUSES

At the beginning of the period covered by this paper, our fuses were very nearly in the same state as they had been during and since the Civil War. The time fuse consisted of a conical wooden plug holding compressed meal powder in an axial bore. The head of this column was provided with an igniting disk of meal powder treated with alcohol in order to increase the ease of ignition. Over all was pasted a paper disk upon which was written the rate of burning of the meal-powder column. To use this fuse, the artilleryman consulted his range table, taking out the time of flight, and then computed the length he must saw off from the small end of the plug fuse to obtain the desired point of burst. The plug was then driven into the fuse seat and the shell pushed down the bore so as to leave the fuse pointing toward the muzzle. The fuse was lighted by the heated gases which passed around the projectile through the windage between the shell and the bore. The maximum time of flight obtainable with such fuses was from 6 to 8 sec.

The Bormann fuse was also used. Its ignition was accomplished in the manner first described, but the meal-powder time train was continued in an annular groove in a pewter fuse body in a manner similar to that now used in the dial-type time fuses. This train was covered with a pewter disk graduated in seconds, which was punched at any desired point for the admission of the igniting flame from the propelling charge. Upon ignition, the train burned in both directions until the reinforcing charge was ignited. The combustion of the igniting, or reinforcing, charge ignited the black-powder shell filler.

The concussion fuse was also common. In this fuse,

the time-train stem was made so brittle that it would be broken by the concussion of the shell upon impact regardless of the part of the shell struck. The breaking of the time train admitted the flame to the shell filler at once.

The combination time-percussion fuse (15 sec. and 28 sec., 1891 model) had just appeared at the beginning of the period under consideration, but of detonating fuses we had none. The simple base-percusison fuse was also more or less a novelty at that time in this country.

The year 1892 found us engaged in making road tests with the 15- and 28-sec. combination fuses to test the safety of the plungers in this respect. The use of an aluminum body, or stock, for these fuses was also being next adopted and has since been used in our service in great quantities. This device entered into the 1894-model 15-sec. and 28-sec. Frankford Arsenal combination fuses.

At the time under consideration, there were two general types of time elements for fuses: one, the dial type similar to that now used with our 3-in. field-gun material, and the other, the spiral lead-inclosed time trains familiar to our service in the Frankford Arsenal 15-sec. and 28-sec. fuses. The former was apparently the German type and the latter a French idea. As we had purchased considerable material from the Hotchkiss company at that time, it is perhaps not unnatural that the spiral type should have been adopted. However, experience has proved it to be inferior to the dial type.

Fig. 5. At Front

Fig. 6. In Rear

FIGS. 5 AND 6. EFFECT OF SERVICE 12-IN. PROJECTILE ON ARMOR PLATE

considered in order to convert the weight so saved into shrapnel balls. Five-inch and 7-in. common shrapnel were at this time being designed for the then new siege material of these calibers. Experiments were also made during this year with the Merriam base-percussion fuse. This fuse is particularly interesting as it embodied, at an early date, many features the importance of which was not apparently appreciated until several years later. The plunger restraining springs and the adjustable delay-nondelay device, are among the features referred to.

The earliest fuses manufactured at the Frankford Arsenal had plungers of the Hotchkiss type, in which the barbed firing pin was inclosed in a lead-filled plunger, the idea being that upon setback in the gun, the plunger would ride relatively backward over the barbed pin and expose the point of the firing pin in readiness for impact. This type of plunger was radically defective, inasmuch as this relative movement would occur gradually under the slight shocks incident to transportation, thus arming the plunger. This condition eventually led to a serious accident, after which the type was abandoned.

The ring-resistance type of plunger invented by W. J. Dungan, an employee at the Frankford Arsenal, was

The development and issue of the time fuses referred to, continued for several years; but it was not until about 1900 that serious efforts were made to develop a dial-type fuse at Frankford Arsenal.

In 1899 the matter of fuses seems to have been taken up in earnest and the "A," "17A20," "C," "M," and "W" fuses were developed. At the same time the development of detonating fuses received consideration. The "A," "C," "M," and "W" fuses are familiar to most of the artillery officers of our service as base-percussion fuses of different sizes appropriate for the various fuse seats and setback conditions.

The detonating fuses were difficult to develop, for the reason that violent explosives must be carried in them in sufficient quantity to excite insensitive shell fillers, while at the same time the fuses must successfully withstand a high rate of impact retardation as well as bore acceleration. Fulminate of mercury was much distrusted, so the early development was along the line of a nonfulminate fuse. The work of developing a satisfactory detonating fuse was continued through 1899 and 1900 until in 1901 the type had been established.

The succeeding two years, 1902 and 1903, witnessed the

early development of centrifugal plungers and their adoption. This period also covered the earlier work with delay-action fuses, and the first steps in the development of the 1906-model dial-type combination fuse. In 1904, centrifugal plungers were further developed and certain old types of base percussion fuses became obsolescent. This year also marks serious attempts to develop a practical side-impact fuse for use in certain mortar shells which at that time were unsteady in flight. The attempts, however, did not lead to the adoption of a new type of fuse, though the devices tested were most ingenious.

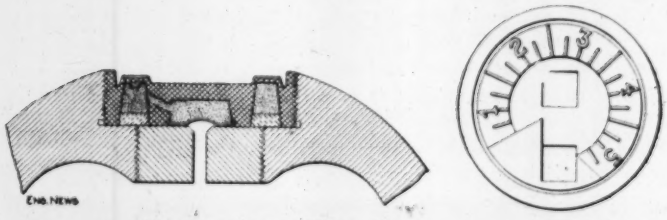

FIG. 7. PLUG TIME FUSES
[For Land Use (left); For Seacoast Use (right)]

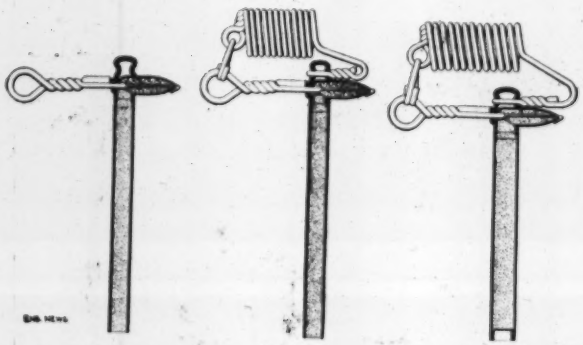

FIG. 9. EARLY MODELS OF U. S. FRICTION PRIMERS

In the following year, the present standard types of detonating fuses were approved for manufacture; i.e., the minor-, medium-, and major-caliber base-detonating fuses. The Hacherelle mechanical time fuse was also tested with poor results. Fuses of this type have in the last few years been brought to a fair state of perfection by the great ordinance corporations of Europe.

The 1906-model dial-type combination fuse appeared the following year, but was immediately succeeded by the 1907-model combination fuse with hooded venting, the type since standard in our service. During this year, 1906, the centrifugal plungers previously developed were abandoned, except for ordnance giving very low bore accelerations. The work of developing a 31-sec. dial-type combination fuse was inaugurated to provide a fuse for the new 3.8-in., 4.7-in. and 6-in. siege material.

The Semple centrifugal plunger was tested during 1907 and 1908, being adopted in 1909, after numerous and prolonged tests. The years 1909 to 1911 have witnessed continuous efforts to develop a satisfactory high-explosive shrapnel for the several calibers of mobile artillery material, together with fuses suited to such projectiles. During this time, fuses have been designed and tested for balloon-gun projectiles and also for hand and rifle grenades.

Our progress in producing fuses has not been so rapid as it has been in Europe, due partly to the fact that we are not equipped so well as our friends across the water. In one country, there are five great ordnance-manufacturing establishments, each maintaining a permanent corps

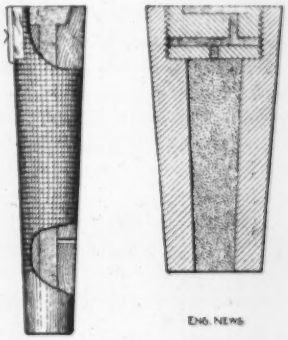

FIG. 8. THE BORMANN TIME FUSE

of the best obtainable specialists for experimental and research work alone. However, in spite of handicaps, our time, percussion, and detonating fuses do not compare unfavorably with those of similar foreign types.

PRIMERS

At the beginning of the period 1892-1912, we find but few primers in service, the radial-vent friction primer and the similar axial- and radial-vent electric primer, together with the obturating friction-screw primer for seacoast guns, representing the equipment.

In 1893 the friction primer for axial and radial vents received the safety wire coil connecting the body of the primer to the lanyard, so that the former would not be blown to the rear from an axial vent, as in the 3.2-in. field gun, and thus form a dangerous missile. In 1896 this safety wire was further improved. Some of these primers are shown in Fig. 9.

It was not until 1900 that the subject of primers was taken up seriously with a view radically to improving them. In this year, single-wire obturating electric primers were developed, and electric primers for 5-in. and 6-in. rapid-fire guns provided. This year also marked the first development of obturating electric friction primers without screw threads on the primer body.

The whole subject of primers was investigated in the succeeding four years and in 1904 the following primers were adopted: 110-grain percussion, 20-grain percussion, 110-grain igniting, 20-grain igniting, 20-grain saluting igniting.

It was during this year that the Horney firing mechanism for seacoast guns appeared, and that the development of a threadless combination electric friction primer for use with it was undertaken. In 1906 electric firing circuits were attached to the seacoast carriages, and by 1907 all of the primer seats in seacoast guns of 5-in. caliber and upward had been modified to receive the combination electric friction primer. During the years 1909, 1910 and 1911 further changes in the firing mechanism and primers have been considered and improvements of various kinds proposed and tested.

Reservoir Regulation for the Ottawa River

By Emile Low*

The subject of river regulation by storage reservoirs is now receiving much attention, and it is therefore of interest at this time to record what Canada is doing in this field. The reports of the Department of Public Works give much valuable information concerning the Ottawa River storage, construction work on which is now well advanced. The writer has abstracted such salient points from these reports as will give the readers of Engineering News some knowledge of the status of the work.

Origin of the Storage Scheme

During the extensive surveys made several years ago for the proposed Georgian Bay ship canal, it was found that no satisfactory scheme could be devised unless it included efficient regulation of the Ottawa River flow by storage of the spring floods, in order to reduce the fluctuations in the different reaches, to eliminate swift and dangerous currents, and to establish practically slack-water navigation.

Conditions on the upper Ottawa are very favorable to a partial control of the surplus waters to increase the low water flow.

The Ottawa drainage basin is 56,000 square miles in area; 10,000 of this lies south of the river, and 40,000 north of the same; 20,000 square miles of this latter, above Mattawa, forms the Timiskaming basin. The upper Ottawa basin contains Grand Lake Victoria, 40 square miles, and Quinze Expanse, 100 square miles. The outlet of Lake Timiskaming in a stretch of 15 miles descends 300 feet over rocky barriers that present wonderful visions of water power, all of which, however, has been disposed of by lease for the remainder of this century.

To the west of Lake Timiskaming is Lake Timigami, and to the east of Timiskaming is Lake Kipawa. The latter has a surface of 100 square miles and is 300 feet higher than Timiskaming. The flow of the Ottawa at Mattawa was 110,000 cu.ft. per second during the flood of May, 1909. The flow of the Ottawa River is a maximum in April each year during the period of melting snow.

After June, the river steadily falls. September, generally witnesses a low stage, but usually there are autumn rains that fill the subsoil of the basin and sometimes cause a rise of consequence. The ground water, coming out all winter from the swamps, serves to maintain the flow during January, February and March, when the frost covering stops all surface run-off.

Rainfall over the Ottawa in summer is even, and there are no steep hills to rapidly shed their load of water upon alluvial plains which have not sufficient slope to carry it away. Except then for the concentrated run-off in May and June, due to the accumulation of snow, there is no great flood, although autumn rains create local rises.

Reservoir Capacity

During the session of 1908-9 Parliament voted the sum of $65,000 to commence the construction of storage dams in the Ottawa valley, previously recommended by Mr. G. P. Brophy, superintendent of Ottawa River Works. Another sum of $20,000 was voted to continue the studies of the Ottawa River watershed.

As a result of these studies, it was decided to construct storage dams at the outlets of three large lakes on the Ottawa watershed, Timiskaming, Kipawa and Lakes Quinze and Expanse. The combined water surface of these three lakes has an area of some 370 sq. miles and it is possible to store in them by regulating their outlets over 6000 sq. mile feet of water, which instead of rushing to waste in the spring flood would be held in these reservoirs and gradually let out during the low water period.

Taking the low period at 150 days between October and March, it will then be possible ultimately to augment the low water flow at Ottawa for that period by 10,000 to 12,000 cu.ft. per second. Large as these reservoirs are, they will not be sufficient to exert the full control that is desired during years of extreme floods but further storage may be created by dams at the outlets of Lakes Turnback, Opasatika, Grand Lake Victoria, Birch, Barrière, Kakabonga, and several other lakes on the main stream or on the tributaries, which are now either under study, or will be investigated as soon as time and staff are available.

Cost of Storage Reservoir Dams

The three first reservoirs of the Ottawa River reserve system, the Timiskaming, the Kipawa and the Quinze, which are under construction, will have a storage capacity of 168,000,000,000 cubic feet of water.

While for a certain number of years it will not be possible to operate these reservoirs at their full capacity, on account of timber to be cut around the reservoirs for the high reserve stage contemplated, time required to settle some of the land damages, possible deficiency of inflow during low springs and other causes, it is confidently expected that the winter flow can be so regulated as to make room for over 100,000,000,000 cubic feet of water at the end of the winter in the three reservoirs mentioned. The great benefit to be derived from this conservation of surplus water in the way of mitigation of floods, regulation of flow for power purposes, raising the low level plain in the navigable stretches of the river, can be secured at an estimated total expenditure of, say:—

Timiskaming dam	$200,000
Kipawa River dam	38,000
Gordon Creek dam (Kipawa)	40,000
Quinze dam	300,000
Damages, surveys, etc.	150,000
Total	$728,000

These dams will all be concrete permanent structures, with the stop-log type of sluiceways, well adapted to conditions on the Ottawa River. They will not therefore require frequent renewal as would be the case with timber dams, and will require only small expense for maintenance.

Other reserve dams will also be built of concrete, except in cases where it will be impossible to transport cement to the dam sites at a reasonable cost. The figures show that great benefits will be derived for a relatively low expenditure by the construction of the first three reservoirs of the reserve project under study, and that this expenditure will be well justified. The ultimate object is to benefit navigation, but in their operation due regard has to be given to other legitimate interests.

*606 Ashland Ave., Buffalo, N. Y.

A Cotton Storage Shed of Economical Design*

By E. S. Pennebaker, Jr. †

The Mobile & Ohio R.R. has erected a large cotton-storage shed on its docks at Mobile, Ala., to provide for the protection of cargoes of export cotton from damage by bad weather. It is a timber structure 135x410 ft., covering a smooth concrete floor, and fronting the Mobile River.

The building was erected and thoroughly equipped by labor contract, the railway company furnishing all materials. The work was done under the supervision of the construction department and completed in approximately 60 working days at a cost of 22.2c. per sq.ft. of floor area, exclusive of fire line and lighting, or at a total cost of 27.5c. per sq.ft. of floor area. This structure covers a floor area of nearly 1 1/3 acres, and has a capacity of 7000 bales of compress cotton piled single tier. It is provided with ample fire protection, is lighted with tungsten lamps, and is served with track facilities which reduce to a minimum the cost of shipside delivery.

As will be seen from Fig. 1, the butterfly type of roof has been utilized to advantage. This permits the employment of low-pitch, shallow-truss construction, effects maximum economy in roof-framing, sheathing, and roof-covering, and affords ample clearance for cars on either side of the building. In addition, the high eaves afford excellent light along the outside bays, and provide much better light throughout the interior bays than is ordinarily secured in buildings of similar width and height, with few skylights. The employment of this type of roof also obviates the necessity of guttering, the roof drainage being taken care of through downspouts in the valleys and subdrains to the river. All timber is long-leaf yellow-pine.

A roof load of 30 lb. per sq.ft. was assumed, about 20 lb. less than the ordinary practice for structures of this type. This 20 lb. represents the snow and sleet load, which can safely be eliminated along the Gulf Coast. The various items which make up this loading are as follows:

Material	Lb. per sq.ft.
Sheathing, 6x6 in., t. & g., l.l. y.-p.	4.00
Composition; felt, asphalt, gravel	10.00
Wind load; 40 lb. per sq.ft. on 1-25 pitch	1.60
Dead load; rafters, purlins, rods, etc.	6.00
Excessive rain, downspouts clogged	8.40
Total	30.00

*Abstract of a paper read at a meeting of the Western Society of Engineers (Chicago), Nov. 11.

†Engineering Department, Mobile & Ohio R.R., Mobile, Ala.

Roof

The roof is carried on trussed beams of built-up section bolted together. These beams (Fig. 2) have a span of 30 ft., and are tied together the full width of the building in series of four trusses each. These series of trusses are spaced 20 ft. on centers, this arrangement of column spacing giving a 7½-ft. overhang of the eaves on the sides of the shed, and a 5-ft. overhang at each end.

In order to eliminate waste ceiling height and reduce the height of columns to an economical minimum, the 4x12-in. purlins, in addition to performing their primary function, act as struts for the trussed-beams. The main compression members of the truss consist of four pieces 2x6 in., bolted together through the columns and through fillers over the purlins. One of these pieces is a rafter moved a few inches from the regular spacing and bolted to the beam to insure additional strength.

The use of a beam of this type and of the same depth as the rafters, was primarily necessary as a detail of the type of construction adopted. It also accomplished economy in material and facilitated erection. In addition, it aided in securing the prompt delivery of material for the building, the timbers being stock size, readily available for quick delivery and at a reasonable price.

The tension in the trussed-beams is carried by 1½-in. round steel rods, which support the purlins on cast-iron bearing knees, and are connected with clevis-nuts and cotters at the ends to ⅝-in. steel plates, which are supported by the 2x12-in. longitudinal girders. Turnbuckles afford a means of adjusting the tension in the rods after the roof is swung. The four spans in the series-truss are securely tied together and fastened at the ends of the outside bays by a combination of a square nut and heavy cast washer, where the rods pierce the outside longitudinal girder.

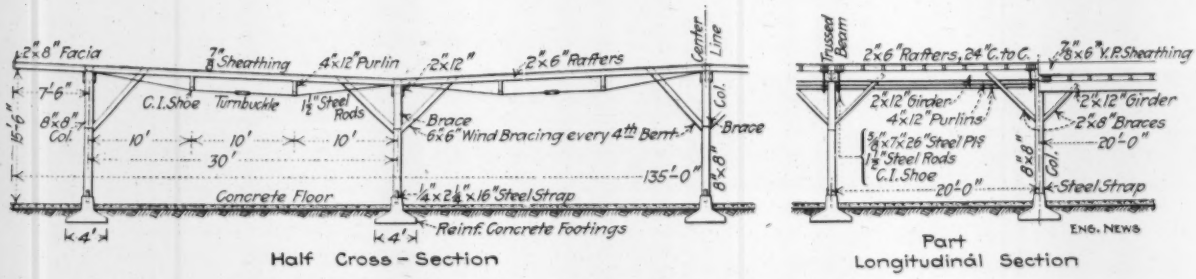

Fig. 1. Cotton Storage Shed; Mobile & Ohio R.R.

The truss depth, center of beam to center of tension rod, is 19 in. The 4x12-in. purlins, with the 2x12-in. girders, are spaced 10 ft. centers. The column spacing of 20 ft. longitudinally was adopted largely because the limiting length of the purlin and girder designed for a roof loading of 30 lb. per sq.ft. is approximately 20 ft. The rafters were arbitrarily spaced 2 ft. centers.

Columns and Footings

The columns are 8x8-in. timbers, dressed four sides. A much smaller column would safely support the load, but owing to the liability to injury or displacement by heavy trucks or drays when unloading cotton under the

shed, it was thought best to adopt this size. Longitudinal 2x8-in. bracing is provided at every column, bolt-connected through the columns and through the two girders. Wind bracing of 6x6-in. timbers is provided at every fourth series-truss as shown in the cross-section in Fig. 1. Eave-ties, 2x8-in., have been placed at each of the outside columns on either side, the full length of the building.

The column footings are of slag concrete; 1: 2½: 5. They are designed for a safe crushing strength of 8 tons per sq.ft., and an allowable foundation pressure of slightly over ½ ton per sq.ft. The foundation is largely pumped-in river sand over clay and sand, and confined within timber bulkheads. As a precaution the bases of the footings (4 ft. square) were reinforced with ⅜-in steel rods arranged in two layers at right angles to each other, the rods in each spaced 6 in.

Floor

The concrete floor has proved to be economical and serviceable. It consists of a 4-in. slab of slag concrete (1: 3: 6,) with a 1-in. top of cement mortar, smoothly finished. The slab is cut into sections 10 ft. square to prevent cracking, and sufficient asphalt expansion joints

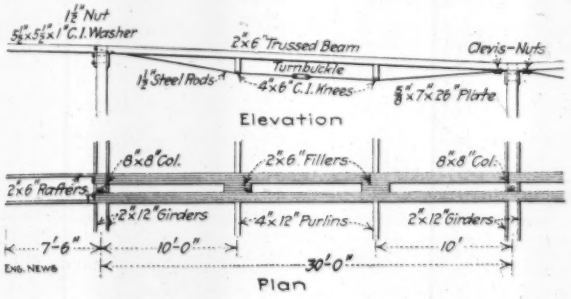

Fig. 2. Trussed Beam for Roof of Cotton Shed

are incorporated for safety. So far, the floor has stood well under very heavy trucking.

Roof Drainage

Galvanized iron downspouts, with roof-entrances capped with wire screens, are spaced 40 ft. apart along the two valleys of the shed. They are fastened to the columns with wrought-iron straps, and convey the drainage to vitrified-tile subdrains laid about 2 ft. below the concrete floor and carrying the water through the bulkhead to the river.

Fire Protection

The requirements of the Fire Underwriters for the protection of cotton-storage warehouses are unusually rigid, and the cost of fire protection is quite an item in a timber shed of this type. The building is equipped with a 4-in. fire line, supplied from the city mains, and tapped by six plugs. Each fire plug is equipped with hose supported on swinging bracket reels. In addition, there are 100 galvanized-iron fire buckets suspended from the columns for emergency use. One or two ships have been discovered on fire while loading cotton, and the fire line has rendered excellent service.

Lighting

During the busy shipping season, it is necessary for the steamers to work night and day taking on cargo. The lighting system includes tungsten lamps with Hubbell diffusive reflectors. A 100-watt tungsten light is suspended in the center of each one of the 84 bays, and the results obtained are satisfactory. Current is supplied by the city electric plant. Arc lamps are used along the pier fronting the shed.

Construction Cost

Detailed cost data were secured, and below are given a few of the unit costs covering material in place in the building; these indicate Gulf Coast costs. All common labor was negro labor. The figures do not include freight.

Reinforced-concrete footings for columns, $3.93 per cu.yd.; concrete floor (slag), 62.96c. per sq.yd.; lumber in place in superstructure, $20.73 per M.B.M.; steel rods, plates, etc., in place 4.61c. per lb.

Creosoted Wood Block Pavement Laid by City Day Labor in Minneapolis*

By Ellis R. Dutton†

The city of Minneapolis has at the present time over 1,000,000 sq.yd. of creosoted wood block pavement, laid by day labor.

In 1901, the city officials began investigating to find a better paving material. The sheet asphalt was unsatisfactory, being put in under a guarantee which was not lived up to, and holes remained in the paving for a whole season. The brick paving was too noisy and the sandstone blocks wore badly.

Quite a few people opposed creosoted wood block pavement, remembering the experience we had had with the old cedar blocks which had been used so extensively. Notwithstanding the opposition a street was paved in 1902, the city purchasing 4-in. southern yellow pine blocks treated with 12 lb. of "Kreodone" oil, which was a trade name for a better quality of creosote oil.

There were then laid 13,500 sq.yd. and the cost for the pavement, complete, was $2.79 per sq.yd., the city of Minneapolis doing all the work by day labor and purchasing the blocks at $1.95 per sq.yd., f.o.b. Minneapolis. These blocks were laid upon a 6-in. natural cement concrete foundation, over which was spread a 1-in. cushion of sand, upon which the blocks were laid at an angle with the curb of about 62°.

There were no cross expansion joints used, only a 1-in. joint on each side of the street next to and parallel with the curb. These joints as well as the joints between the blocks were filled with paving pitch, and the street was finished with a ¼-in. coating of sand to absorb the excess pitch on top of the blocks. In laying these blocks, we considered that it would be better to lay them at an angle with the curb instead of at right angles, both on account of the travel and also the expansion, and the correctness of the assumption has been proven by experience.

In the experimental blocks which were laid by the Forest Service, the creosoting company and the city of Minneapolis, observations made in 1912 prove

*Paper presented at the ninth annual convention of the American Road Builders' Association, Cincinnati, Ohio, Dec. 3-6, 1912.

†Assistant City Engineer, Minneapolis, Minn.

that it is better to lay the blocks at an angle of approximately 62° as that method shows less wear of the joints than any other. The pavement laid in 1902 has proved a complete success, as there have been practically no repairs on account of the blocks, and the wear has been only about ⅛-in. up to the present time.

This pavement looked so good and seemed to be so satisfactory, that in 1903 it was determined to lay more of this class of paving. Minneapolis is situated in a pine country and is one of the largest centers of pine lumber manufacture, so it was asked "Why not use our native Norway pine for the work?"

The matter was discussed and finally it was decided to use Norway pine, treated the same as the yellow pine. Accordingly, arrangements were made for the erection of a treating plant in Minneapolis, if the city would use 30,000 sq.yd. of creosoted Norway pine blocks. The price of this class of blocks was $1.64 per sq.yd., f.o.b. Minneapolis, using 12 lb. of "Kreodone" oil per cu.ft.

In the paving of Third Ave. South in 1903, there were left over from 1902 about 300 yards of the yellow pine blocks which were used in this street, and the remainder was Norway pine. In 1911, I took out some samples of these two classes of wood, which had received exactly the same travel and wear, and found that the yellow pine blocks showed a wear of ⅛-in. and the Norway pine blocks twice as much—¼-in. This was an actual comparative test of the two kinds of wood on the same street and under the same conditions.

In 1904 the price for blocks was $1.73 per sq.yd., f.o.b. Minneapolis, but there were proposals as low as $1.51 per sq.yd., using common commercial creosote oil. The engineers and the paving committee considered the higher priced blocks, treated with the best grade of oil, to be the better and cheaper. It was believed that the oil which contained the larger percentage of residue after distillation to 315° C. was the better. The cheaper oil showed 43% of residue and the best showed 70% of residue. The latter was used and there was much criticism made and much newspaper notoriety given the matter, but the wisdom of the purchase has been shown by experience.

The specifications of 1905 required an oil of a gravity of 1.09 at 20° C., and specified the fractional distillation percentages. These were the first specifications of the kind and they have been followed throughout the country ever since. The idea of specifying what is required should be adopted for all classes of paving and paving materials, as it places the contractors on an equal footing, and the municipality gets what it asks for provided the engineers know how to get it.

This brings up the question of inspection, and there is no class of paving that requires more rigid inspection than the creosoted blocks, and if it is possible to obtain a competent person to do the inspecting it is money well spent.

We raised the amount of oil per cubic foot to 16 lb. this year, as it was considered better to fill the wood more thoroughly and make the blocks more waterproof. This amount has not been changed since, though other cities have put in 20 lb. or more, which I think has caused other trouble.

We continued the use of Norway pine, tamarac and hemlock until 1911, when we returned to the yellow pine blocks which seemed to give the best results, especially on heavily traveled streets. We used a 3½-in. block on the lighter traffic streets. We have had no trouble with our creosoted block pavements, though on one particularly heavily traveled street the Norway pine blocks have worn about 2 in., and will soon have to be relaid.

On Jan. 1, 1912, we had a total of 968,000 sq.yd. of creosoted wood block paving, put in at a cost of $2,[illegible]-000, or an average of $2.52 per sq.yd. The prices have varied, as the prices of material varied, from $2.29 per sq.yd. in 1908 to $2.82 per sq.yd. in 1907. The price of the crushed limestone used in the concrete base averages about $1.75 per cu.yd. delivered on the street. The sand costs about 75c. per cu.yd., and portland cement has cost from 86½c. to $1.80 per bbl. delivered f.o.b. Minneapolis, depending on the year.

The cost of paving as given above includes the grading for the foundation, the laying of the concrete base, the paving blocks, pitch and all the labor connected with making a complete pavement. I have not heard of a city that gets as much for the money as we do. The city of Minneapolis does all of its public work by day labor and has done so for the past 12 years, with the exception of asphalt paving, which it could not do as it had no asphalt plant. The wages paid common labor in paving work have increased from $1.75 per day of 10 hours to $2.40 per day of 8 hours in 1912. The costs of skilled labor and teams have increased almost as much in proportion.

We have tried to eliminate the question of politics from the work, and have been partly successful, but the political question is the weak point in the day-labor system. All work is done under the direction of the City Engineer, but is ordered by the City Council through the various committees, such as water-works, sewer, paving, etc. All materials are advertised for and contracts awarded by the City Council. I think that as a general thing we get better work and better materials under this system than in much of the work done by the contract system.

To show the preference for the different kinds of paving, from 1902 to 1912, the following table is given:

Kind of Pavement.	Square Yards Jan. 1, 1902	Square Yards Jan. 1, 1912	Increase
Sheet asphalt	206,471	164,441	42,030*
Brick	171,144	390,869	219,725
Creosote blocks	.....	967,616	967,616
Granite blocks	156,994	403,915	246,921
Sandstone blocks	61,661	347,939	286,278
Macadam	129,305	335,159	205,854

* Decrease.

I think the people's preference for wood block paving has been largely on account of the success we have had, as we have had no "buckling," "bleeding" or other difficulties which have been experienced in other places.

There are several things necessary to properly construct a creosoted wood block pavement:

1—The proper kind and quality of wood.
2—The proper kind and quality of oil.
3—The proper amount of oil and treatment.
4—The blocks must be laid properly.
5—The joints must be filled properly.
6—The pavement must be cared for properly after construction.

I have touched on almost all of the points, and if they are looked after properly in a careful manner by competent persons, you will get the best pavement it is possible to obtain at the present time.

A Proposed Code of Ethics for Engineers

The committee appointed by the Council of the American Society of Mechanical Engineers to prepare a code of ethics for adoption by that society rendered a report on Dec. 9, with a draft of a proposed code, which it recommended should be submitted to the society's membership in advance of its adoption, to give opportunity for discussion and criticism.

In submitting its report to the Council, the committee urged that eventually such a code should be adopted by all the national engineering societies for the guidance of their members, and further, that since the same ethical standards and principles should be observed in all branches of the profession, eventually the societies should agree upon a uniform code.

In drafting the present code, the committee has endeavored to make it applicable to engineers generally and not to the special field of the mechanical engineer alone. The code follows:

A. General Principles

1. It is not assumed that this code shall define in detail the duties and obligations of engineers under all possible circumstances. It is an axiom that engineers in all their professional relations should be governed by principles of honor, honesty, strict fidelity to trusts imposed upon them and courteous behavior toward all. The following sections are framed to cover situations arising most frequently in engineers' work.

2. It is the duty of engineers to satisfy themselves to the best of their ability that the enterprises with which they become identified are of legitimate character. If an engineer after becoming associated with an enterprise finds it to be of questionable character, he should sever his connection with it as soon as practicable, avoiding in so doing reflections on his previous associates.

B. The Engineer's Relations to Client or Employer

3. The engineer should consider the protection of a client's or employer's interests his first obligation, and therefore should avoid every act contrary to this duty. If any other consideration, such as professional obligations or restrictions, interfere with his meeting the legitimate expectation of a client or employer, the engineer should so inform him.

4. An engineer cannot honorably accept compensation, financial or otherwise, from two or more parties having conflicting interests without the consent of all parties. The engineer, in whatever capacity, whether consulting, designing, installing or operating, must not accept commissions, directly or indirectly, from parties dealing with his client or employer.

5. An engineer called upon to decide on the use of inventions, apparatus or anything in which he has a financial interest, should make his status clearly understood by those employing him.

6. An engineer in independent practice may be employed by more than one party, when the interests of the several parties do not conflict; and it should be understood that he is not expected to devote his entire time to the work of one, but is free to carry out other engagements. A consulting engineer permanently retained by a party, should notify other prospective clients of this affiliation before entering into relations with them, if, in his opinion, the interests might conflict.

7. Before any consulting engineer takes over the work of another consulting engineer he should ask the client his reasons for desiring to change engineers and unless the consulting engineer is entirely satisfied that the client has good and sufficient reasons for making the change he should confer with the present incumbent before accepting the work.

8. Consultations should be encouraged in cases of doubt or unusual responsibility. The aim should be to give the client the advantage of collective skill. Discussions should be confidential. Consulting engineers should not say or do anything to impair confidence in the engineer in charge unless it is apparent that he is wholly incompetent or the interests of the profession so require.

9. Engineers acting as experts in legal and other cases, in making reports and testifying, should not depart from the true statement of results based on sound engineering principles. To base reports or testimony upon theories not so founded is unprofessional.

10. An engineer should make every effort to remedy dangerous defects in apparatus or structures or dangerous conditions of operation, and should immediately bring these to the attention of his client or employer. As failure of any engineering work reflects upon the whole profession, every engineer owes it to his professional associates as well as to himself that a reasonable degree of safety be provided in all work undertaken.

C. Ownership of Engineering Records and Data

11. It is desirable that an engineer undertaking for others work in connection with which he may make improvements, inventions, plans, designs or other records, should first enter into an agreement regarding their ownership.

12 If an engineer uses information which is not common knowledge or public property, but which he obtains from a client or employer, resulting in plans, designs or other records, these should be regarded as the property of his client or employer.

13. If a consulting engineer uses only his own knowledge, or information which by prior publication, or otherwise, is public property and obtains no engineering data from a client or employer, except performance specifications or routine information; then in the absence of an agreement to the contrary, the results in the form of inventions, plans, designs or other records should be regarded as the property of the engineer, and the client or employer should be entitled to their use only in the case for which the engineer was employed.

14. All work and results accomplished by an engineer in independent practice in the form of inventions, plans, designs or other records, which are outside of the field of engineering for which a client or employer has retained him, should be regarded as the engineer's property unless there is an agreement to the contrary.

15. When an engineer or manufacturer builds apparatus from designs supplied to him by a customer, the designs remain the property of the customer and should not be duplicated by the engineer or manufacturer for others without express permission. When the engineer or manufacturer and a customer jointly work out designs and plans or develop inventions, a clear understanding should be reached before the beginning of the work regarding the

respective rights or ownership in any inventions, designs or matters of similar character that may result.

16. Any engineering data or information which an engineer obtains from his client or employer, or which he creates as a result of such information, must be considered confidential by the engineer; and while he is justified in using such data or information in his own practice as forming part of his professional experience, its publication without express permision is improper.

17. Designs, data, records and notes made by an employee and referring exclusively to his employer's work, should be regarded as his employer's property.

18. A customer, in buying apparatus, does not acquire any right in its design, but only the use of the apparatus purchased. A client does not acquire any right to the plans made by a consulting engineer except for the specific case for which they were made, unless there is an agreement to the contrary.

D. The Engineer's Relations to the Public

19. The engineer should endeavor to assist the public to a fair and correct general understanding of engineering matters, to extend the general knowledge of engineering, and to discourage the appearance of untrue, unfair or exaggerated statements on engineering subjects in the press or elsewhere, especially if these statements may lead to, or as made for the purpose of, inducing the public to participate in unworthy enterprises.

20. Technical discussions and criticisms of engineering subjects should not be conducted in the public press, but before engineering societies or through technical publications.

21. It is desirable that the first technical descriptions of inventions or other engineering advances should not be made through the public press, but before engineering societies or through technical publications.

22. It is unprofessional to give an opinion on a subject without being fully informed as to all the facts relating thereto and as to the purposes for which the information is asked. The opinion should contain a full statement of the conditions under which it applies.

23. Engineers engaged in private practice should limit their advertising to professional cards and modest signs in conformity with the practice of other professions.

E. The Engineer's Relations to the Engineering Fraternity

24. The engineer should take an interest in and assist his fellow engineers by exchange of general information and experience, by instruction and similar aid, through the engineering societies, the engineering schools or other means. He should endeavor to protect all reputable engineers from misrepresentation.

25. The engineer should take care that credit for engineering work is attributed to those who, so far as his knowledge of the matter goes, are the real authors of such work.

26. Criticism of the work of one engineer by another should be broad and generous with the facts plainly stated. The success or failure of one member reflects credit or discredit on the whole profession.

27. The attitude of superiors toward subordinates should be that of helpfulness and encouragement. The attitude of subordinates to superiors should be one of loyalty and diligent support. The treatment of each by the other should be open and frank.

28. The attitude of an engineer toward contractors should be one of helpful coöperation. Tact and courtesy should be combined with firmness. An engineer should hold a judicial attitude toward both parties to a contract for whose execution he is responsible.

29. An engineer in responsible charge of work should not permit non-technical persons to over-rule his engineering judgment on purely engineering grounds.

F. Interpretation

30. If two or more engineers, members of this society, disagree as to the interpretation of this code, or as to the proper rules of conduct which should govern them in professional relations to each other, they may agree to refer the matter to a standing committee of the society on the interpretation of the code. Each party shall submit a statement of his position in writing, and the committee shall render a decision. A permanent record shall be made of the cases so submitted and decided.

31. Amendments or additions to this code may be made by the standing committee on interpretation of the code, subject to the approval of the Council.

Chas. Whiting Baker, *Chairman*
Chas. T. Main,
E. D. Meier,
Spencer Miller
C. R. Richards.
} *Committee on Code of Ethics*

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The Port of Para, Brazil, is very completely and interestingly described in the October, 1912, "Bulletin" of the Pan-American Union. Para is on the Para River, which belongs to the Amazon system, though not on the main outlet to the largest river bearing that name. It was established as a town as far back as 1700, and has taken its place as the largest rubber shipping port of the district. In 1910 the vessels entering the Port of Para numbered 1969 steamers and 1668 sailing vessels with a total tonnage of nearly 1,500,000 tons. The opening of the Madeira-Mamoré Ry. promises to add considerably to the use of the port.

In November, 1907, work was begun on a system of docks with accessory appliances, which provide permanent facilities for the present traffic of the city of Para, as well as for the traffic present and to come from that immense area known as the Amazon Valley, and although addition must later on be made to the docks as they exist now, yet the unit of improvement has been established and further expense should be nothing more than a duplication of that unit. The work is being carried on under an American corporation holding its concessions from the federal government of Brazil. To it is given a monopoly of the port services, construction, and operation of quays, warehouses, and other works at Para within a zone of 18 miles toward the ocean and 12 miles in the other direction, for a period of 65 years, and this period is to extend to 90 years after the completion of the second section of the work.

The main channel to the port has a depth of 30 ft., and a total width of about 400 ft. between chanel-line buoys. This leads up to the dock, which consists of about one mile of quay wall for ocean-going steamers where there is a depth of 30 ft. at low water of ordinary spring tides. In addition, there is 722 ft. of quay wall for river steamers with a depth of water of 12 ft. and 1500 ft. of quay wall for still smaller river steamers with a depth of water of 9 ft. 6 in. The quay walls are built of large concrete blocks. Back of the quay is a well paved platform or roadway on which are warehouses and freight handling machinery. Beyond the warehouses on the city side of the port works proper is a newly finished road about a mile long and 60ft. broad, making both a boulevard and, with the trees which are being planted, a future park.

In addition to the port works proper, the company is building a ship repairing depot with floating drydocks and necessary shops.

The first section of the port works was formally inaugurated in October, 1909, and work is now going on toward the final completion. The article in the bulletin is written by Albert Hale, of the Pan-American Union staff.

A New Design of Centrifugal Dredging Pump

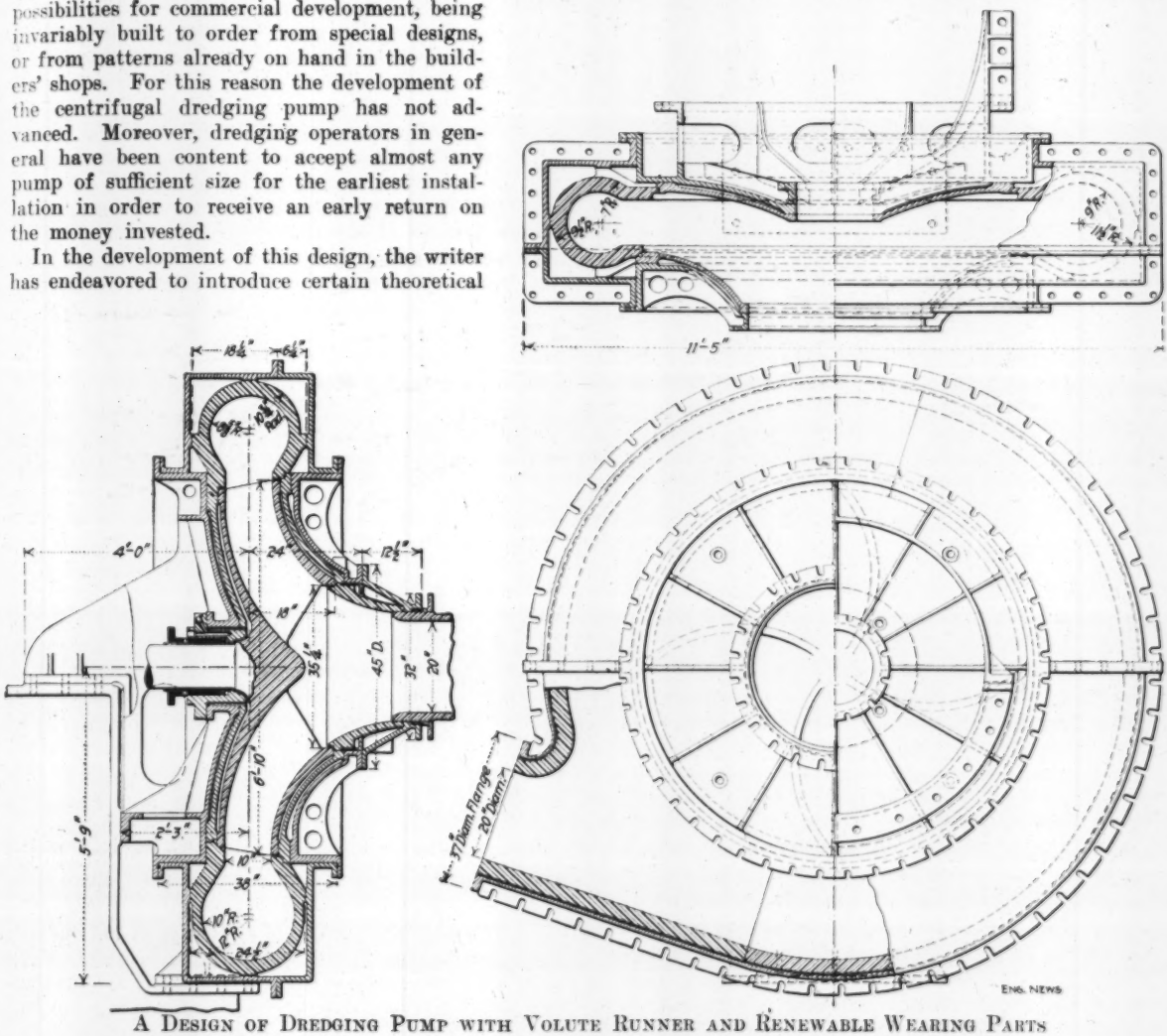
By H. S. New*

The development of the centrifugal pump for clear water during recent years has attained a very promising status, due in a measure to the fact that this service offers the best commercial field. Dredging pumps of this type are in a special class and offer extremely limited possibilities for commercial development, being invariably built to order from special designs, or from patterns already on hand in the builders' shops. For this reason the development of the centrifugal dredging pump has not advanced. Moreover, dredging operators in general have been content to accept almost any pump of sufficient size for the earliest installation in order to receive an early return on the money invested.

In the development of this design, the writer has endeavored to introduce certain theoretical elements without interfering with the practical features so necessary in a dredging pump. The aim was to produce a pump as near the volute type as possible, with the volute portion renewable and permitting of such alterations in its shape and design as experience would demand, without requiring a change in the exterior of the pump and its outside connections or fastenings. It is understood that the peripheral volute linings can be made of any metal desired and with a minimum of machine work.

A dredging pump must not only be an efficient power consumer, but it should permit of easy and quick renewals at low cost. It is the enormous wear on this type of pump and not the cost of driving that is the main feature of expense.

The service conditions met with in hydraulic dredging are so varied and the character of the materials handled so dissimilar, that a strictly theoretical design for this service would be useless, if not impossible. It therefore becomes necessary for the designer to be perfectly familiar with the conditions of service, and then to introduce as much of the theoretical in the design as knowledge of working conditions permits.



A Design of Dredging Pump with Volute Runner and Renewable Wearing Parts

The dredging pump of the present day is a single-stage, low-speed or high-speed type required to pass and propel material mixed with water, varying from silt, mud, sand, clay, roots, gravel, coral, small boulders to a miscellaneous assortment of foreign things often encountered during dredging operations. Some of the latter are a real menace, oftentimes causing instant destruction of the pump and loss of complete plant.

A dredging pump is required to propel material of specific gravity of 1.0, and above, through a winding pipe line the length of which may be anywhere from 500

*90 West St., New York City.

ft. or less, to 6000 ft., lifting it from depths of 30 to 40 ft. and discharging anywhere from zero to 50 ft. above the center of the pump. These conditions vary from hour to hour. It may thus be realized that a dredging pump can never be made to attain the efficiencies secured with the clear-water types, and simplicity in design and construction is imperative. Some parts will meet with considerably more wear than others, and even the same part at different stages of operations will work under entirely different conditions. For these reasons the writer has endeavored to produce a pump which will meet these peculiar conditions, the several parts being easily replaced and by members whose design may be altered in accordance with the lessons to be learned from the practical side. These alterations in the pump should not interfere with the operations of the plant to a greater extent than required for the change of substitution of parts. The largest pieces of the pump must be of weights and dimensions that permit handling by gear readily available for the purpose; a differential block and trolley beams are of invaluable assistance.

The design presented herewith is a development of a design of pump which met with extremely severe conditions on the New York State Barge Canal, and is now in successful operation there. The pump during one month handled 201,000 cu.yd. of stiff clay and large gravel through a pipe line 1000 ft. long, dredging at a maximum depth of 12 ft. and discharging 25 ft. above the water surface. The total number of hours during which the pump operated in the month was 520.5, making an average of about 283.5 yd. excavation per hour run. This pump, however, was not a volute type; the runner was 68 in. in diameter, used at 220 r.p.m.

The new pump (see accompanying figure) consists of a light exterior casing of cast iron inclosing the wearing parts of the pump proper. It will be seen that for the same casing we may alter the size of the pump, so to speak; that is, this particular design shows what is known as a 20-in. pump, but we can insert an entire new interior of smaller or larger size, making either a 24-in. or a 16- or 18-in. pump. It would seem absurd to have such a larger outer casing for the smaller size of pump, but if we had the large pump on hand, and desired to build a smaller dredge, it would be a very easy matter to design an interior of small size to suit the casing on hand, and by this means save money.

The outer casing is composed of the peripheral portion made in four parts, split in a horizontal plane through the center, and vertically through a plane at right angles to the shaft. The line of vertical division is towards the front, making these parts of unequal size. The covers are in circular pieces suitably ribbed and dished in form, carrying the liners which are bolted to them with taper bolts having no heads. The contact surfaces between liners and covers are made a minimum so that cost of machining may be reduced. The volute lining may, or may not, be bolted to the outside shell; if the bolts are used, taper bolts without heads and flush with the inside surface should be adopted and located where they will receive the least wear. It will be seen that the contact surfaces between the volute lining and shell are very small, and have the merit of minimum machining. The cover linings are shown in one piece, circular and dished, following the shape of the covers, the thickness and kind of material to be determined from the service and type of impeller. It is possible also to use an open impeller or runner if desired. The volute linings are in three pieces, one being a little over 90° in extent, another a complete half circle, while the third is of shape to conform with the discharge. A groove is cast in the ends of each volute lining where they butt together, and when set up in the pump, babbitt or other metal is run in the joints to insure a complete continuous inside surface to carry the dredged material.

The back cover is strongly formed to provide sufficient pads for bolting to the bedplate of the driving engine. The ribs have lightening holes available for convenience in bolting up during erection. Arrangement is also provided for attachment of tackle during the assembling. On the bottom section of the rear peripheral casing is a large pad for supporting and fastening the pump. Parts which have to be frequently taken apart are provided with slotted holes requiring only slacking of the nut on the bolt to permit the bolt to be quickly removed, also avoiding the danger of losing the nuts where the plain holes only are used. To the back cover is bolted a stuffing box carrying the gland through which the runner shaft passes; this stuffing box is fitted with a perforated bronze ring, and supplied with water under pressure. The front cover has bolted to it the tapered pipe carrying the suction liner, vanes or lugs extending on the inside and engaging similar vanes from the outside of the suction liner to keep the latter from turning. The front cover has also an internal gland for setting up packing on the outside of the suction liner; adjustment of this gland is made by bolts passing through bosses on the outside of the taper pipe. Inside the taper pipe and suction liner is a sliding pipe fitted with gland and packing, thus insuring a flexible connection to the dredge hull. Square packing is fitted in grooves turned in the flanges which match the flanges of the covers, similarly packing of this kind is provided in the cover liners where they bear against the volute linings. This style of packing might also be used where the volute linings bear against the sides of the outer casing for a good bolting cushion.

The impeller and shaft are cast in one piece. For the gland, a bronze sleeve is shrunk on the shaft, spare sleeves being kept on hand for replacement.

There are several details of construction not shown in the accompanying figure, and only the principal dimensions are given. The object has been to illustrate as near as possible a type of pump which might be termed "universal" in a sense; that is, the direction of discharge may be to right or left, the angle of discharge with slight alteration to patterns may be varied, also the size and shape of the lining may be varied without affecting the installation in the dredging plant. The cost of this pump will necessarily be slightly in excess of the general run of dredging pumps sold today but the cost per pound will be no more. The saving in a year will amount to the cost of several of the other types.

For any inclined to experiment with this pump, the volute lining could be made up of reinforced concrete in one piece without any great danger, as the writer has in mind where a pump was repaired with concrete until the spare part could be delivered.

EDITORIALS

A new use for steel plate has been found within the past few years, but it is not likely to make any great disturbance in the metal market. Dr. W. A. Lane, a noted surgeon of London, England, is given credit for introducing the use of vanadium-steel plates as reinforcements in setting fractures of the long bones. The process is thus described in the New York *Times*:

> Instead of treating fractures of the bone by the usual splint and extension methods, he cuts down to the seat of the fracture, bores holes in the ends of the bones and applies plates of vanadium steel, known as Lane's plates, which are screwed to the bones. He then closes the wound, applies a dressing, and then puts on the customary plaster cast. Sometimes these plates are left in place indefinitely, but sometimes it becomes necessary to remove them.

A member of the editorial staff of this journal, on visiting the well equipped hospital of the up-to-date construction camp of the U. S. Reclamation Service, at the site of the Arrowrock Dam, near Boise, Idaho, was told by the surgeon in charge that he had recently used steel plates after the general method described. The result was eminently successful, but the patient could not be easy-minded with a piece of steel screwed to his anatomical structure, and so the surgeon removed it—one of the cases of necessary removal mentioned in the foregoing quotation, but a necessity of the brain rather than of the bone.

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More Concerning the Everglades Drainage Work

Most of our readers will recall the articles published during the past year in this journal with reference to the work the State of Florida has attempted looking to the drainage of the Everglades, and our comments on the land sales which have been made in anticipation of this drainage work being completed.

According to an advertisement published in the *Everglade Magazine*, a journal published in Chicago devoted to the promotion of the Everglade reclamation, one of the large companies which has been selling land in the Everglades, has decided to undertake drainage work on its own account. The advertisement says:

> In view of persistent reports to the effect that the State's final drainage plan may be considerably delayed, the Everglades Sugar & Land Co. has decided to anticipate complete drainage of its own land and to that end has authorized a bond issue of $500,000, or approximately $20 per acre. It is the plan of the company to build dikes completely around its land, construct interior canals and a network of large laterals. The plans also call for the installation of enormous pumps with sufficient capacity to remove the excess rainfall should the outlet canals and the dikes of the State prove to be inadequate to accomplish this result by gravity.

It is fair to say, in justice to this company, that it has employed engineers to investigate and report upon the sufficiency of the general drainage plan adopted by the state. We can, of course, pass no opinion here upon the soundness of the company's plan; but at least its proposal is an indication of a desire to protect those who have purchased its lands.

Water-Supply Problems in Westchester Co., N. Y.

A continuous-performance water shortage in parts of Westchester County, N. Y., calls attention to what is alleged to be a double injustice. The City of New York, it is claimed, first appropriated nearly all the available sources of water-supply in the county named, and then, when the legislature made it compulsory for New York City to sell water to municipalities in Westchester County, succeeded in getting the price for water thus sold at wholesale fixed at the price charged private consumers at meter rates in New York City—which is $1.33 per 1,000,000 gal.

It is an ill wind that brings no one luck. The lucky ones in this case, it is alleged (New York City not caring to sell water to outsiders) are several private water companies in Westchester County, which have recently raised their water rates. But these water companies have had their own troubles with water shortages.

One rational solution of the whole problem would seem to be public ownership of all the water-works in the country, and the formation of a county water-supply system, owning and operating supply works only, leaving distribution systems to local ownership and operation. The county organization might then be able to secure amendatory legislation which would permit it to buy water from New York City at a fair price (whatever that might prove to be) instead of an arbitrary one. Failing that, it could, perhaps, provide a supply of its own. Still another plan, which has much in its favor, would be to put the whole matter of water-supply and water-rate adjustment under the control of the State Conservation Commission, successor to the Water Supply Commission.

First and last, there has been altogether too much political and private chicanery over water-supply sources for old New York, Brooklyn and Westchester County. The use of needed sources of supply for Brooklyn, on eastern Long Island, and for New York, in Dutchess County, were prohibited by the legislature, years ago, in the alleged interests of the country districts, but apparently with more desire to help out various private water-supply schemes. Whether the present legislative rate for water supplied by New York City to Westchester County communities was designed more to aid private water companies in that section than to protect New York City, we do not know.

Two things are certain, and these it is which justify discussion here of a situation which otherwise is mostly local: (1) The Conservation Commission or the up-state Public Service Commission should control these local conflicts over water-supplies and water rates, instead of the legislature; and (2) some, if not all, of the communities in Westchester County have been woefully deficient and negligent in making their plans for future water-supplies.

The Status of the Engineer

It is the custom of business firms at some time during the year to make an inventory of their assets, as it is commonly called, "take account of stock." They thus find where they stand and whether they have gone forward or backward during the year past. It seems appropriate for the engineering profession at the opening of a new year to undertake a similar investigation. Even though some engineers may object that it is unnecessary for them to inventory their assets, since they represent what mathematicians call a vanishing quantity, it is at least worth while to consider the profession's present condition and prospects.

And at the start it may be said that the outlook for engineering activity at the opening of the new year has seldom been more favorable. The enormous harvest of 1912 with high prices for farm products have laid a foundation for prosperous business which neither the vicissitudes of political change nor the exploits of high financiers seem able to shake. While the ominous shadow of a dark war cloud darkens the European situation and affects financial markets the world over, peace and tranquility prevail in our own favored land. Activity in engineering work, we need hardly say, is closely bound up with prosperous business conditions, particularly in the work of the civil engineer.

So far so good, but is the engineer justified in stopping at this point? Must he not if he is to make a true inventory, consider not merely the outlook for employment but the conditions under which he and the profession at large are carrying on their work? There is, we believe, substantial unanimity among all the members of the profession, in the higher ranks as well as in the lower, that present conditions leave much to be desired.

For one thing, to refer to a subject often mentioned in the pages of ENGINEERING NEWS, engineers should have a larger voice in the settlement of important public questions in which technical matters are concerned. Money is being wasted by the millions in the expenditures of the national government, of states and of cities, to say nothing of private corporations, for lack of competent engineering design and construction.

The engineer was long ago defined as the man who makes a dollar earn the most interest; but the engineering profession sees millions of dollars expended where they can earn no income, or only a very small one, where sound technical planning would have turned a loss into a profit. This condition is, in fact, a subject of frequent discussion among engineers. Some of the engineering societies have standing committees on the public relations of the engineer. Of many important public questions no correct solution is possible without the aid and advice of the informed and experienced expert engineer.

Unfortunately, the public has little understanding of this fact. It blindly gropes about, placing its trust on this politician, or that business man, or the other high financier. The public knows or thinks it knows men of this sort because it has heard them talked about in the newspapers, but the public knows little or nothing as to the names of the men who are the leaders in the engineering world today.

We are confident that many times the public would be glad to employ and to place its confidence in high-class engineers; but it does not know how to go about the [illegible] of selecting the real engineer from the pseudo-engine[illegible]

Turning now to another sore spot of the engine[illegible] profession, it is a fact that the compensation of [illegible] neers, taking the profession as a whole, is inadequat[illegible] the responsibilities that they carry, and is far below [illegible] enjoyed by men who contribute far less to the wo[illegible]'s welfare. Exceptions to this rule are found in the cas[illegible] of engineers who have abandoned purely technical work, [illegible] who hold high executive positions, or who are carrying [illegible] some line of business.

Of course, it must be recognized that the rewards to be gained by either salaries or fees by a man engaged in strictly professional work are never likely to compare with those enjoyed by a successful business man. In the medical profession, famous surgeons can command enormous fees as the price of saving the lives or limbs of wealthy patients; and in the legal profession, famous lawyers have no difficulty in collecting enormous fees from large corporations who find themselves in legal difficulties. But the man who approaches a consulting engineer is in no such frame of mind as the one who approaches the great surgeon with a plea that an effort be made to save his life, or the noted lawyer with the demand that an opponent be defeated in the courts no matter at what cost. In contrast with the fees of famous lawyers and physicians, it may be said that the engineer's fee is always weighed, measured, and parted with reluctantly by the client.

Besides this, there is to be reckoned with, the overcrowding of the profession, a chronic state which the United States shares in common with all other civilized countries, and which there is no prospect of changing.

There is, however, another point of view from which to look at these handicaps of the engineering profession—liabilities, if we may so term them in our inventory. Even though we cannot expect the client to approach the engineer willing to part with any amount of wealth to save his life or win his case, it is still not impossible that the public may yet come to have a better appreciation of the real value of high-class engineering service.

Again, while the profession is from one point of view overcrowded and there are a host of applicants for every engineering position paying a good salary, it is also true that the man who has the responsibility of selecting an engineer to take difficult and responsible work, either executive or technical, is very apt to find considerable difficulty in obtaining a man in whom he can place entire confidence. Perhaps there are in the entire ranks of the profession plenty of men able to give efficient service in every engineering position, but where shall one look to find them and how can their qualities be determined? In all the array of testing machines in our engineering laboratories, there is no machine which will infallibly weigh the abilities of engineers themselves.

We believe that three-quarters, if not nine-tenths, of the engineers in the profession who have thought of these matters believe that the profession itself ought to do something to better its status. As an indication of the direction in which men's minds are running, we print below a letter recently received in which the situation of the profession is squarely presented. We believe ENGINEERING NEWS can render no greater service to its readers than by laying this letter before them and emphasizing the importance of its contents.

S —During recent years there has been considerable dis ion about the status of the Civil Engineer and his co nsation. Many remedies for existing conditions ha en proposed, but excepting measures discussed by a l local engineering clubs, no concerted action to bet these conditions has been attempted.

th the expert at the head of the profession and the ma at the opposite end of the line have suffered from a lac of knowledge and appreciation by the public of his work. In too large a percentage of cases today, the decision of the larger questions involved in the solution of great engineering problems—questions needing the best knowledge of our leading expert engineers—is made by boards of lawyers, doctors, merchants—in fact by anybody except the engineer.

Believing that some action should be taken in this matter, and that this action should be by the body most representative of the engineering profession in this country, the writer introduced the following resolutions at the annual meeting of the American Society of Civil Engineers last January.

That the President appoint a Committee of eight members to look into the conditions of employment of Civil Engineers throughout the country, the compensation they receive, the duration of employment, the expenses for which they are reimbursed by the employer, the expenses due to the work paid by the engineers themselves, the net yearly income, the prices charged for different classes of private work, and any other facts necessary to clearly set forth the problem. The report to set forth recommendations for action by the Society looking toward improving existing conditions and to include a report on the feasibility of this Society operating an employment bureau for its members covering all classes of engineering work. The Committee to consist of four employing engineers and four engineers holding subordinate positions. The Committee to be authorized to add to its membership and to fill vacancies. A preliminary report to be rendered in six months.

This resolution was referred to the Board of Direction which reported at the August Convention as follows:

(1) That it does not feel that it would be practicable or wise for the Society to operate an employment bureau for its members.

(2) That it feels that it would be of valuable interest to the Society to know the conditions of employment and the compensation of Civil Engineers throughout the country.

(3) That it, therefore, recommends to the Business Meeting of the convention that the matter be referred back to the Board with instructions to appoint a Committee to investigate the conditions of the employment, and the compensation of Civil Engineers throughout the country; to collect statistics and data in regard thereto, and to report the results of such investigation to the Society.

The Society approved the action of the Board; and the Committee for this work will soon be announced. As this matter affects vitally every member of the profession, both in and out of the Society, it seems wise to call attention to the work before this Committee through ENGINEERING NEWS.

It is not expected that any radical action will result from the report of this Committee, but rather that the facts in the case will be established, and that these facts will aid us to determine what action should be taken to bring about the desired results. For undoubtedly there is a long campaign before us before the public can be brought to grant the engineer the authority in engineering matters which should be his, and proper compensation for his services.

It seems desirable that engineers should generally interest themselves in this matter, should secure data for the Committee, should propose lines of action for bettering conditions, and subject all these measures to thorough discussion, both before the Society and in the engineering clubs and papers. To invite such discussion is the object of this letter. To this end a few lines of action are suggested.

1. The American Society should outline and publish sets of standards on engineering ethics, compensation for private work, salaries for various grades of engineering, and classes of allowable expenses for engineers employed upon various work.

These standards should be drawn up simply for reference, in order that the engineer may have a guide as to what the majority of engineers judge to be just and right, the same as he now has a guide in the Society's specifications for cement, etc. While no one would be obliged to adopt such standards, they would be a means of gradually eliminating some of the worst cases of low compensation, would aid engineers dealing with small cities and towns, and by their revision from time to time would furnish a means of increasing the compensation for the entire profession.

Disagreements over allowable expenses cause considerable friction in many engineering organizations. It would seem advantageous to have the Society establish classes of expenses, enumerating in detail for each class what is allowable. An employer offering employment could then specify so much salary and expenses as per Class A (or B, C, etc.) American Society Standard, thus making the term "expenses" perfectly definite.

We need a Code of Engineering Ethics published by some engineering body large enough to represent fairly the profession in this country. Many existing ideas relative to engineering practice seem to need revision.

2. Our present method of marketing engineering services of all grades is extremely crude, unbusinesslike and wasteful, and gives strong color to the often repeated statement that engineers are not fitted to be put in charge of large business matters. Some central body should be created where an engineer's qualifications and references may be kept on file and where employers may seek such services as they need, whether these employers be city authorities seeking expert advice or a chief of party looking for a good transit man.

3. Organized influence should be used to have disputes over purely engineering matters taken from the courts and referred to boards of engineers for arbitration.

4. Engineers as a body should investigate cases like that of the dismissal of C. G. Elliot from the Government service and then should actively aid the side of justice. Assuming the American Society to be the instrument used for this purpose, and if after investigation an engineer should be found guilty of unprofessional conduct or worse, then he should be expelled from the Society, but if not guilty the Society should actively support him.

In fact, we have arrived at a stage where concerted action on the *human* side of engineering is necessary. Some organization of engineers must soon take up this work. As the American Society of Civil Engineers is already in the field with a large membership and an effective organization, it would logically seem to be the proper body to undertake this work. If, however, it should decide that it is unwise for it to undertake such action, then a new organization is needed, and will undoubtedly develop.

PERCIVAL M. CHURCHILL.

Elmwood, Mass., Dec. 2, 1912.

Two or three of the specific matters considered by our correspondent in the letter above deserve special comment here. First, as to a proposed code of engineering ethics: It will be of interest to put on record here the fact that the American Institute of Electrical Engineers, after a long period of discussion and consideration, has formally adopted a code of ethics for the guidance of its members. The Boston Society of Civil Engineers, also has had a committee at work for several months on the preparation of a code for adoption by that Society, which code is, we believe, practically completed.

The American Society of Mechanical Engineers nearly a year ago appointed a committee to investigate and report as to whether it was advisable for that Society to formulate and adopt a code of ethics. The committee rendered a report favoring such action, and thereupon a second committee was appointed to prepare such a code. This committee reported to the Society's Council on Dec. 6, the code which it had drafted and which is based upon the code already adopted by the Institute of Electrical Engineers and that now pending before the Boston Society. Prior to the formal adoption of the code by the Mechanical Engineers' Society, it is to be printed and distributed to the members in the January issue of the Society' *Journal,* and will be open for discussion, criticism and amendment. It is printed on another page of this issue of ENGINEERING NEWS.

It may be said here that this committee in presenting its report especially recommended that in its opinion the different engineering societies should unite in the adoption of a standard code applicable to engineers in all branches of the profession. The drafting of the present code, it is hoped by the committee, may be a step in this direction.

With reference to the question, still more or less debated, as to whether it is any part of the duty of an engineering society to formulate a code of ethics, the committee urged that it is as much the function of an engineering society to place in the hands of its younger members at least, information as to what constitutes proper professional practice in the relation of engineers with each other and with the public as it is to furnish them with standards for their guidance in conducting their technical work.

This is a point often overlooked by older engineers in their consideration of this matter. It is true that the engineer of long experience and high professional standing needs no written code to guide him as to what is proper professional conduct. He has acquired this knowledge, unconsciously often, by his years of experience in contact with other members of the profession. The engineer young in years and experience lacks just this knowledge. He seldom errs through intention, but through ignorance.

In the second place we wish to direct special attention to our correspondent's proposal above that the National engineering societies should establish exchanges for the marketing of engineering services of every sort. We believe if this work is carried out as it might be and as it could be, it would be of greater value to the engineering profession in improving the status of its members than any other work which the engineering societies could possibly undertake. We will go further and say that it would be of greater importance and value to engineers than any and all the work which the societies are now doing, beneficial and important though that is.

As many of our readers will recall, in our issue of [illegible] 17, 1911, (p. 210) we discussed this subject at [illegible] length and explained the general plan on which such an enterprise could be carried out with a certainty of success.

Let us make the situation definite. Within the last month there have come to us a number of applications from parties desiring to engage engineers for important and responsible positions. During the same time there have been as many or more inquiries from engineers desirous of securing positions. In not a single case, however, did it happen that an applicant had the special experience necessary for any of the positions for which candidates were desired.

This experience is, we need hardly say, not exceptional but typical. Every engineer of wide reputation is in constant receipt of letters from those who desire to secure professional employment and also of letters and inquiries from parties seeking engineers. It would be worth a great deal to hundreds of busy engineers if they were able to refer both classes of applicants to a high-class central bureau to which a man desiring a position could resort without the slightest loss of professional prestige, and to which the client or the employer desiring engineering services could go with confidence that he could there secure the special type of man he stands in need of.

Is not the position of the engineering profession, when one stops to consider, little short of absurd at the present time? Engineers complain because the public does not appreciate the difference between the high-class engineer and the amateur: between the engineer of education, experience, and intelligence, and the man who conceals a vast array of ignorance and incompetence behind a promising exterior and a valuable tongue. But how is the layman who desires to employ an engineer, to know where to find competent men of professional standing? Has the profession ever provided a place where those who desire engineering service could go, with confidence that high-class men could there be procured?

There is serious complaint in the engineering profession that engineering is becoming a commercialized business, that the independent engineer can no longer meet the competition of the big engineering companies which employ dozens or hundreds of engineers on a salary.

But the gravitation of engineering work to these big combinations is as natural a result as the fall of the apple to the ground. The public has little knowledge of engineering matters. All engineers look alike to it, and it is equally distrustful of all. It places its confidence in the big engineering combination because it feels that behind that combination there is capital and responsibility. The public knows how to find this concern, but it does not at all know how to find the independent engineer even though be could by his personal interest in the work give better results to the client than the big engineering combination.

There are many other matters that might be touched upon in discussing this need. We will mention at this time only one other, and that is the stimulus which would be given to the growth and standing of the engineering societies in the profession were such a plan successfully carried out.

With all that the national societies are doing for the profession and for their members, it cannot yet be said that they comprise anything like the proportion of the active membership in the profession that they should. Hundreds and thousands of engineers remain outside of the societies or drop out after holding membership for a time because they feel that what they receive is not worth what it costs. But if the national societies were to undertake such a work for the whole profession as is outlined above, it would be recognized by engineers of all classes that here was an achievement the value of which none could gainsay.

We believe, moreover, that such a plan as we here outline would have greater effect than any other possible action that the profession could take to secure an increase in compensation for engineers. We believe the public is willing to pay a fair price for high-class engineering service when it can be assured that it is actually receiving it.

On the other hand, it is also true that to raise the compensation of engineers would enable them to do better work. If the engineer is to deal successfully with the large questions on which he alone is competent to pass judgment, he must be able to be a man among men; he must have a position of reasonable independence, financially and otherwise. And the converse proposition is equally true. It is only human nature to set a low value on that which costs us little. In order that the public shall properly appreciate the value of engineering service, it is necessary that the compensation of engineers shall be put upon a proper plane.

LETTERS TO THE EDITOR

The Lake with a Long Name

Sir—In your issue of Dec. 5 you say that the draftsmen plotting the surveys on the extension of the Grand Trunk Ry. system to Providence, R. I., were unable to spell the name of Lake Chaubunagungamaug. May I suggest that what the draftsmen really stumbled over was not the abbreviated name of this lake, which you give as above, but its full name, which is Chaugoggomauchaugchaubunagungamaug!!

I learned the name of this lake from an old inhabitant while I was engaged in the construction of a waterworks system for the town of Dudley, which adjoins the lake. The translation of this remarkable Indian name, as I recall it, is "the meeting of the three waters," referring to the three streams which feed the lake. While I would not take oath to the accuracy of this translation, I hardly think it could be contradicted, as there are few now living who could translate the Indian tongue in which it occurred.

J. H. SERRA.

15 Halsey St., Brooklyn, N. Y.

Nature and Conduct of the Slides in the Culebra Cut

Sir—After reading the article under the above title in the Nov. 28 issue, I am reminded of the story of the traveler who, driving up to a country inn, threw the lines into the hands of a small boy and thus addressed him:

"Diminutive specimen of primogeniture, expeditiously extricate yon equine quadruped from the vehicle, stabulate him, provide him with a sufficient quantity of suitable provender, and when Aurora shall gild the Oriental horizon, bring him forth and I will remunerate you munificently for your generous hospitality."

The boy, dumbfounded, rushed into the house, exclaiming, "Father, there is a Dutchman out there, that wants a glass of beer."

I had no idea it took so many words to describe an "everyday earth slide."

EMILE LOW.

606 Ashland Ave., Buffalo, N. Y.

Should a Pier Be Permitted in the North River for a Hudson River Bridge?

Sir—Mr. Lindenthal's letter to the New York *Times*, reprinted in this week's ENGINEERING NEWS, and your editorial comment thereon, are most interesting and timely.

ENGINEERING NEWS says that in the engineering profession one would look far today to find doubt that such a bridge as Mr. Lindenthal proposes is entirely feasible. Most engineers and especially bridge engineers would take the feasibility of the bridge for granted on Mr. Lindenthal's indorsement.

But the public is ignorant, suspicious and timid. The failure of the Quebec bridge, the widely published criticisms of the strength of the Blackwell's Island bridge, and the fact that Mr. Lindenthal's proposed North River bridge will exceed by more than 1000 ft. the clear span of the longest finished bridge will, taken altogether, not tend to create favorable public sentiment.

It may be taken for granted that Mr. Lindenthal is not advocating a 3000-ft. span for the everlasting glory of the bridge engineer, but has worked up a design for this enormous span because of the opposition of the War Department to piers in the river.

The present attitude of the War Department, backed up by some river interests and founded on an inherited Anglo-Saxon superstition in regard to the sacredness of waterways, is a formidable obstacle for bridge builders to overcome; but not so bad after all as it would be if the water in the Hudson River at the site of the proposed bridge were 1000 fathoms deep.

If Mr. Lindenthal could offer a cheaper bridge by putting one or two piers in the river, everybody who wants the bridge should help him get the piers.

Any craft or tow that is so unmanageable that it cannot avoid a stationary, visible obstacle like a bridge pier with a quarter of a mile or more of navigable water on each side of it, should be kept out of a busy crowded harbor in the interest of other vessels.

Ft. of West 5th St., AUGUSTUS SMITH.
Bayonne, N. J., Dec. 23, 1912.

Test of a Steel Overshot Water Wheel

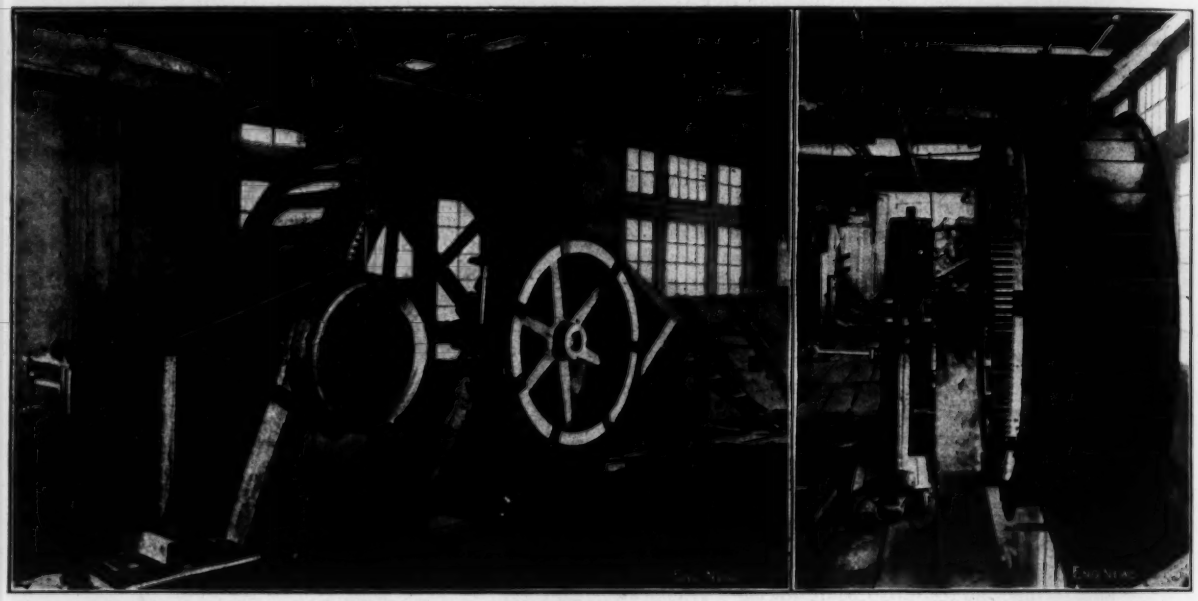
By C. R. Weidner. *

A series of tests on a 10-ft. steel overshot water wheel have recently been completed at the hydraulic laboratory of the University of Wisconsin, the results of which may be of interest to engineers who have occasion to develop small water powers.

A large number of American engineers consider the overshot water wheel as out of date—a relic of the past which has been replaced by the turbine, and for modern hydro-electric developments of large power there can be no question as to the superiority of the latter. The overshot wheel, however, is still capable of serving a distinct field, where the power to be developed is small and the speed of the machinery is slow and requires but little regulation. The fact that wheels of this type are still being installed in Germany and France, after careful engineering investigation, for small factories, pumping plants, and even for the development of electrical energy, may be taken as an indication of satisfactory and economical use of this type of motor.

The overshot wheel was formerly constructed of wood and a number of picturesque and interesting examples of this type of construction still remain in this country. In recent years, however, the wheel has been built entirely of steel and iron. Although the initial cost of a wooden wheel is less than one built of steel, the latter possesses certain advantages which makes it more desirable to install, notwithstanding the increased cost. Unless a wooden wheel be kept continually in operation, the constant swelling and drying of the wood soon causes all parts to get loose; the buckets leak and a considerable percentage of the available energy is wasted. In a steel wheel the buckets can be shaped more readily to accord with the design; a larger percentage of the total head is made available on account of the smaller thickness of the metal; and the friction in the bearings is decreased because a steel wheel is lighter than a wooden wheel well soaked with water. For these reasons the steel wheel is more efficient. Moreover, it is more durable, the cost of maintenance is less, and the parts are more readily assembled.

Fig. 1, shows an example of a steel overshot wheel of modern design—the wheel tested at the University of Wisconsin. Wheels of this type have been installed in various parts of the United States and South America. The buckets are formed by curved vanes attached to the cylindrical surface or inner circumference of the wheel, called the soling, and to the segmental circular housings on the sides. The vane thus forms the front or outer part of the bucket, the soling the back or inner side, and the housings form the sides. The buckets, soling, and rims are made of flanged steel riveted together. To the housings are bolted the radial arms, made of flat bar steel, which in turn are bolted to cast-iron center flanges keyed to the shaft. Power is usually taken from the wheel by means of gearing and is transmitted by shaft, belt, or rope drive. In some designs the segmental spur gearing is bolted to the arms of the wheel, as in Fig. 1, in others a gear wheel is keyed directly to the shaft. The manufacturers furnish either ball or roller bearings as specified.



Figs. 1 and 2. Front and Side Views of Overshot Steel Water Wheel Equipped for Testing; University of Wisconsin Hydraulic Laboratory

The advantages of the overshot wheel are; (1) high efficiency, (2) adaptability to varying discharge, (3) simplicity in construction, (4) reliability, (5) no interference of operation on account of clogging with débris or ice.

Of these advantages the first two are of the greater importance. The results of the experiments discussed below show high efficiencies under a wide range of operating conditions. Reliable tests of turbines have been

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reported yielding as high as 89% efficiency,* but it is rare that this figure is attained in an actual installation. In the smaller plants especially, where an overshot wheel would be capable of competing with a turbine, it is doubtful whether the turbines operate with an average efficiency higher than 70%. It is, however, extremely difficult to make any comparision as to the efficiency of two types of motors, unless both have been tested under exactly similar conditions of operation. The installation of a turbine requires a technical analysis of the problem, and unless the turbine is set properly and selected for the particular conditions under which it is to operate, the efficiency will fall far below that of which it is capable when operating under the proper conditions. Very few of the small water powers developed receive the proper engineering supervision to promote a high degree of efficiency in their operation. The overshot wheel, on the other hand, suffers but little from a lack of proper design or selection, although to obtain the highest efficiencies of which the wheel is capable, it is not advisable to dispense with a technical analysis.

To engineers familiar with the variation in efficiency of the turbine at part gate, a glance at the curves obtained from the Wisconsin experiments (Fig. 4) will be convincing as to the superiority of the overshot wheel, in respect to its adaptability to varying discharge. The experiments show that the range in the discharge may be as much as 400% with only a difference of 5% in the efficiency of the wheel. The other advantages cited are of minor importance, though in particular cases they may influence the choice of type of motor to be selected.

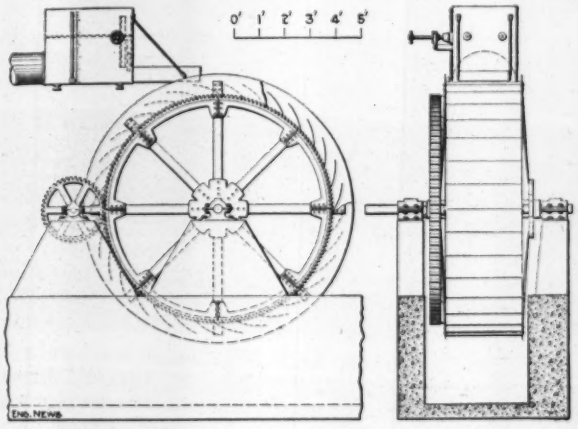

FIG. 3. CONSTRUCTION OF STEEL OVERSHOT WATER WHEEL IN UNIVERSITY OF WISCONSIN HYDRAULIC LABORATORY

The limitations or disadvantages are; (1) an economical limit in respect to the head and discharge to be developed, (2) a limit in respect to the speed of the machinery to be operated, (3) a limit in respect to the variation in the water levels in the head and tail races, (4) larger space requirements than a turbine.

On account of the increase in the weight of the wheel, as the head or discharge is increased beyond a certain limit, the cost of the overshot wheel becomes so great that it can then no longer compete advantageously with the turbine. The economical field of the wheel, therefore, lies in developments which range approximately between 2 and 30 cu.ft. per sec. discharge, with heads varying from 10 to 40 ft., corresponding to a maximum development of about 75 hp. Within this field, the question whether to install a water wheel or turbine must be decided on the basis of the particular conditions of the power to be developed, the class of machinery to be operated, and the cost of installation. Only a rough approximation can be made as to the cost of the two types of motors, from the figures furnished by the manufacturers. In general it may be said, that the initial cost of an overshot wheel, up to a diameter of 16 ft., will be about twice that of a turbine of equal horsepower, and above that diameter a little more than twice the amount.

The peripheral velocity of the overshot wheel, when operating efficiently, varies approximately between 3 and 7 ft. per sec., depending on the diameter, discharge, and velocity of the entering water. Hence, there would be a practical limit to the speed of the machinery to be served, beyond which the loss of power through the necessary gearing would probably offset any gain in efficiency. It is, therefore, particularly adapted for the operation of slow-speed machinery, and should find a field of usefulness for the operation of small factories, the machinery on farms or country homes, and especially for pumping plants, where the pumps may be connected directly to the wheel shaft. For the operation of high-speed machinery, a loss of from 3 to 10% may be estimated to occur through the necessary gearing or belting.

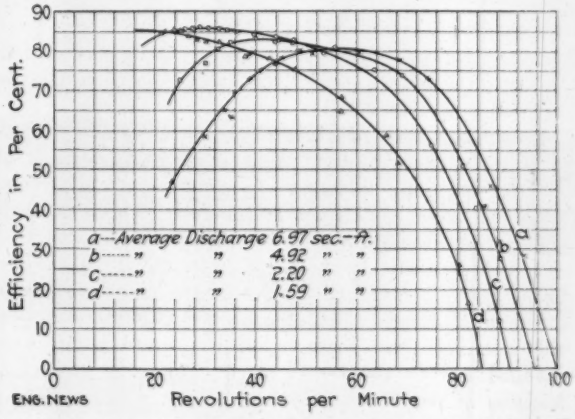

FIG. 4. EFFICIENCY-DISCHARGE CURVES OF A STEEL OVERSHOT WATER WHEEL
(Power Measured at Jack Shaft)

The principal application or use of water power at present is the development of electrical energy. In general the opinion is held, that only turbines on account of their high speed are applicable for this purpose. However, a number of electrical plants, operated with water wheels, have been built and are giving satisfactory service. The inertia of the heavy wheel and gearing provides a very uniform motion, and high efficiency at part load is a very desirable feature in electrical plants. It is a matter for the designing engineer to decide, which type of motor will give the highest total efficiency, for a plant of this kind.

*Trans. Am. Soc. C. E. Vol. LXVI, p. 306.

The efficiency of the overshot wheel drops off quite rapidly if the bottom of the wheel is submerged, even though this is but a few inches; therefore, the wheel is poorly adapted to conditions where there is a considerable variation in the tail-water level. The turbine will operate almost as efficiently when submerged as when not submerged, and by use of the draft tube there is but little occasion to have it submerged. In this connection it should be noted, that in periods of flood, when the water wheel is likely to be submerged, there is an excess of water and as the wheel is particularly adapted for overload capacity, the extra power developed would probably make up for any decrease in efficiency.

Within these limitations the overshot wheel is capable of serving a field in water-power development, and of competing successfully with the turbine both in efficiency and cost of operation. The decision as to water wheel or turbine must be made after careful investigation of the particular conditions to be met with; each type of motor should receive equal consideration. The considerations which influence this choice are; (1) head and discharge available, and probable variation in these, (2) cost of the motor, including setting and foundation, (3) relation of motor cost to available capital for plant construction, (4) class of machinery to be served, and whether continuous or intermittent power supply is required.

Laboratory tests of a machine, when properly interpreted, undoubtedly have a great value, but it must be borne in mind, that any test so made represents results under the exact conditions of the test. The conditions under which the Wisconsin experiments were performed approached practical conditions very closely. The wheel tested was of a standard pattern taken from the stock of the manufacturers. The structural features are simple, and none of these features, of the wheel itself, were changed during the tests. Apart from the structural features of the wheel, the chief factors which influence the efficiency are the velocity of the entering water, the relation between this velocity and the peripheral velocity of the wheel, and the discharge. The results should, therefore, be readily duplicated in actual service, if the wheel is set properly, and they may be taken as a guide in the design and installation of this type of water wheel.

A summary of the conclusions reached in the experiments, the details of which will be published in a University bulletin,* is given below.

Summary of Conclusions from Experiments

(1) The maximum efficiency obtained was 89% of the theoretical input delivered, at the wheel shaft or 86% at the jack shaft.

(2) The transmission loss, through the spur gear and pinion, including the friction in the bearings, reduced the efficiency of the wheel 3% at maximum efficiency of operation. Within the limited range of the experiments this loss increased with the speed and decreased with the horsepower transmitted.

(3) The efficiency of the wheel, other conditions remaining constant, increased with the decrease in the entrance velocity of the water. This statement is limited, however, by the fact that for maximum efficiency a definite relation exists between the peripheral velocity and the entrance velocity, so that a limit is reached when the entrance velocity equals or slightly exceeds the peripheral velocity.

(4) The variation in the discharge within reasonable limits, so that the coefficient of filling does not exceed approximately 0.50, has little if any effect on the efficiency of the wheel.

(5) For maximum efficiency of operation, the ratio of the peripheral velocity of the wheel to the velocity of the entering water is a constant, whose value is approximately 0.90.

(6) Submergence of the wheel in the tailwater causes a serious decrease in the efficiency. A submergence of 3 in. caused a loss of 6% at maximum efficiency of operation, which loss increased rapidly as the submergence was increased.

(7) For maximum efficiency, the point of impact of the water should lie as high in the wheel as possible. The point is regulated by the distance of the entrance spout or orifice from the wheel, and must be adjusted for each installation, otherwise a serious loss of energy occurs at entrance.

*"Theory and Test of an Overshot Water Wheel," by C. R. Weidner. Bulletin of The University of Wisconsin, No. 529.

A Warehouse Telpherage System*

The arrangements for carrying merchandise into and out of the warehouse of M. A. Newmark & Co., Los Angeles, Calif., show an interesting attempt to reduce the cost of handling through the elimination of labor, breakage, and confusion, and by expediting receipts and deliveries. This firm is a large wholesale grocer and importer, receiving and delivering on an average 200 tons of goods daily, the goods consisting of a general miscellaneous line of every size package, box and barrel. With merchandise varying from a box of chewing gum to a hogshead of molasses, the handling problems were more complicated than with uniform freight.

This firm has recently erected a new reinforced-concrete warehouse, with four floors and basement, besides a mezzazine above the first floor. When designing the building, the handling problem was considered and a telpherage system was installed, together with two spiral chutes and four elevators.

The telpherage system comprises three motor-driven two-ton carrier cars (Fig. 1), traveling on the lower flange of an I-beam track. The carrier frame is suspended from two four-wheel trucks placed 7½ ft. apart. Only the forward truck is motor-driven, the maximum speed being 500 ft. per min. Both trucks are swiveled so that the carrier can round a curve of 10 ft. radius. On each side of each truck there is a current-collector shoe which bears on an angle-iron conductor running along each side of the I-beam track. Direct current at 500 volts is used and the contact between the shoe and the angle iron has proved so good that there has been no sparking. The hoisting motor on the trolley is gear-connected with the horizontal drum bars, one at each end of the carriage. Two hoisting ropes are suspended from each one of these bars and

*From information supplied by the Brown Hoisting Machinery Co., Cleveland, Ohio.

The loaded trucks are suspended on these four ropes. The maximum hoisting speed is 50 ft. per min., but this speed is seldom attained, owing to the short distance the load is raised. The load is held at any desired height by either of two brakes, a solenoid brake, which releases only when the hoist motor is driven by current, and a mechanical friction brake, which operates only on the downward travel of the load. Either one of these brakes is sufficient to carry a load of double the capacity of the carrier. The operator rides on a platform placed at the rear of the trolley and the two controllers, one for hoisting and one for trolley travel, are placed just in front of his seat.

The single-rail track is suspended from the ceiling in every gangway on the various floors (Fig. 1) and is provided with the necessary track switches, which are operated from the floor. Three of the four elevators are equipped with the I-beam tracks, which align with the track on each floor. The operator runs his trolley on the elevator and takes it to the different floors, running the elevator from his seat on the trolley. The elevator tracks and all switches are provided with safeay stops to prevent the trolley from running off the track.

The company uses four-ton automobile trucks for delivery service. These have special bodies, consisting of two similar sections, each 6 ft. 9 in. long by 5 ft. 8 in. wide. These body sections are detachable from the frame of the auto trucks so that they can be picked up by the trolley one at a time and carried into the warehouse. At the front of the building (Fig. 2) there are three I-beam tracks extending out over the street for a distance of 27 ft.; the auto trucks back up to the curb beneath these tracks and are loaded and unloaded by the trolleys. The tracks are covered with a canopy to protect the work during bad weather. During the rainy season, the auto trucks are equipped with special automobile tops, which open lengthwise of the truck, sufficient to allow the trolleys to pick up the bodies. These tops have a very simple lock device and are arranged so that they are very easily operated.

The body sections carry permanently attached two wheels in the middle and a small roller at each end, so that they can be pushed around the floor in the warehouse to be loaded direct from different piles of merchandise. The body sections can be locked into place on the trucks.

Practically all goods are received in carload shipments and railroad tracks run along the rear of the building. Just inside the building and parallel to the railroad track, is one of the telpher tracks. All goods are unloaded from the cars to hand trucks somewhat smaller than the automobile-body sections, so that they can be easily worked through the car doors. The trolley carrier places an empty truck close to the car door and where it can be pushed into the car and loaded by four men. It is then pushed out and under the trolley track, the carrier picks it up and carries it to any part of the building. The two rear elevators are used almost exclusively for unloading freight, and this is usually done in the morning. Loads are carried to the storage department in less than two-thirds the time required by the old methods and with two less men.

In assembling orders for outside shipments and city delivery, both spiral chutes and the trolleys are used. When the orders are for small quantities, the goods are sent to the first floor through spiral chutes and the orders assembled there on automobile bodies. When the order is large, the goods are assembled on one of the body sections right at the storage departments and carried to the delivery entrance on the first floor by the trolleys. Very often the auto-truck bodies are loaded direct from a car shipment and placed on the first automobile truck that comes in, the goods being handled only once.

The loaded body sections are assembled on the first floor at the front of the building, awaiting arrival of the trucks. There are thus always loaded bodies waiting with goods checked ready to go out. When the trucks back up, the empty bodies, or loaded ones in some cases, are lifted off and replaced with others made up for deliveries. The average time of this exchange is 5 min., but it is expected that this will be cut to 4 min. The record time is 3 min. 10 sec. It is reported that the same loading could not be done within an hour, or an hour and a half for a truck arriving loaded.

The general system above described was designed by Leland S. Rosener, of San Francisco; the trolley carriers and track switches were designed, built and installed by the Brown Hoisting Machinery Co., of Cleveland, Ohio.

FIG. 1. AUTOMOBILE-BODY SECTIONS IN TRANSIT FIG. 2. LOADED BODIES READY FOR TRUCKS

FIGS. 1 AND 2. WAREHOUSE TELPHERAGE SYSTEM OF M. A. NEWMARK & CO., LOS ANGELES

(Designed by L. S. Rosener, San Francisco.)

Methods of Tests for Concrete Materials*

The present report emphasizes the necessity for more rigid requirements for the acceptance of concrete materials and for routine tests of the materials and the concrete.

Tests of the individual materials are not sufficient for determining the quality of the concrete made from them. A certain sand may give satisfactory results with one brand of cement and prove a failure with another. A sand of a certain granulometric composition may require an entirely different proportioning with one coarse aggregate than with another or may be unsuited for use with it because of the sizes of the grains.

The Committee recommends that for all important structures, such as dams, conduits, and buildings, specimens of concrete be made up in advance of the actual work from materials which it is proposed to use in the work. These specimens should be made under laboratory conditions so as to obtain uniformity in mixing and storage, and with the same consistency which is to be used in the proposed structure. The specimens should be stored in moist atmosphere and compressive tests made at the age of 28 days and also at other periods if practicable. The final selection of the materials and the proportions to be adopted should be governed by the results of these tests.

The tests now in progress in different laboratories under the auspices of the Committee are expected to furnish data from which definite recommendations may be made as to the size and shape of the specimen. The Joint Committee on Concrete and Reinforced Concrete recommends cylinders 8 in. diameter by 16 in. high. Where it is impracticable to adopt this size, a 6-in. cube or a cylinder 6 in. in diameter and 6 in. high is tentatively suggested for use with aggregates under 1½ in. in size. It must be borne in mind that specimens of this shape may give from 10 to 20% higher strength than the same materials made into oblong cylinders or prisms.

Tests of materials for use in mortar or concrete may be divided into two general classes:

(1) Tests for acceptance.

(2) Tests for quality.

These two divisions frequently merge into each other because in many cases the special characteristics of a sand may render it unfit for certain work, although it may satisfactorily pass a standard test for acceptance.

The most important questions to be asked in regard to a material are: (*a*) Can it be used? (*b*) In what proportions must it be mixed with the other materials to produce the required qualities in mortar or concrete? (*c*) Can another material of the same class be substituted with greater economy?

For small structures and, in fact, frequently for larger ones where the sources of supply are limited, the all important question is a combination of the first two, namely, can a certain material—and this applies most frequently to the fine aggregate or sand—be used, and in what proportions to give the desired quality of concrete or mortar? For structures where the volume of the concrete is large so that the economy of the proportioning is paramount, or for small structures subjected to special conditions such as the effect of sea water—the cement and aggregates should be thoroughly studied also and special tests made to determine the most economical or the qualifications for the work proposed.

Taking the matter of the selection of sand alone, an illustration of the poor quality that is frequently used in practice is found in the tests in the laboratory of one of the members of the Committee. Out of 37 samples of sand from different parts of the country made into 1:3 mortar, 12 were equal to or greater in strength than similar mortar of standard Ottawa sand; 5 were between 90 and 100% of standard sand; 6 were between 80 and 90%; 4 were between 70 and 80%; 6 were between 60 and 70%; 1 between 50 and 60%; 2 between 40 and 50%; and 1 between 30 and 40%. Such results as these indicate the absolute necessity for always testing sand that is used in concrete. For large and important structures, such as dams, tunnels, aqueducts, buildings, and other reinforced-concrete work, not only preliminary tests should be made but frequent tests at stated intervals to avoid the danger of inequalities in the supply.

Tests of Materials for Acceptance

Cement—The cement should meet the requirements of the Standard Specifications for Portland Cement of the American Society for Testing Materials.

Fine Aggregate—Sand or other fine aggregate should always be tested. In ordinary cases where special characteristics are not required, the test for acceptance is the determination of the strength of mortar made up with the cement and fine aggregate to be used on the work in comparison with the strength of identical specimens made with standard sand. The results of this test also are an aid to the selection of the proportions which should be adopted.

Compression tests of mortar are the most reliable, but tensile tests may be employed when a compression machine is not available.

Selection of Sample—Take an average sample aggregating 20 lb. Ship in strong box or bag or barrel, so that laboratory will receive material in its natural condition. Ship in a separate package from the cement.

Quartering—Unless grains are of uniform size, separate from the large sample the quantity required for the test by quartering or other similar means.

Making Specimens—Mold a large enough quantity so that there will be at least four specimens each to test at 72 hours, 7 days, and 28 days, in proportions one part cement to three parts sand by dry weight. Bank sand should not be dried, since drying may affect the quality, but the percentage of moisture should be determined by test on another sample, and corrected for in making the weights. The consistency should be the same as that required for standard sand mortar. From 10 to 40% more water may be required for bank sands or artificial aggregates than for standard Ottawa sand to produce the same consistency.

Similar specimens of the same cement mixed at the same time under the same conditions should be made with standard Ottawa sand in the same proportions.

All temperatures of mixing and storage should be maintained at 70° F. During the first 24 hours the specimens

*Portion of Report of Committee on Specifications and Methods of Tests for Concrete Materials, National Association of Cement Users; presented at Annual Convention, Pittsburgh, Penn., Dec. 10-14, 1912.

should be stored in moist air and the remainder of the period in water.

The 72-hour test is the most severe and sand failing to attain the requirement at this age frequently reaches it at 7 or 28 days and can be accepted. If, however, the 72-hour briquettes break in the clips of the machine or if the specimens at this age show very low strength, say 25%, or below, of the strength of standard sand mortar, the sand should be considered dangerous to use on any important work of construction.

Requirements for Strength—The aim in concrete construction should be to obtain a sand which produces a 1:3 mortar equal in strength to a similar mortar of standard Ottawa sand. Sands producing mortars having a strength of less than 70% of standard sand mortar should be rejected.

Between these two limits the variations in strength should be taken into account in fixing the proportions of the mortar or concrete.

Other Tests—For work requiring special characteristics, the fine aggregate must be accepted not merely on passing the tests for strength, but other tests, such as the test for permeability, the effect of different brands of cement, the effect of frost action and the effect of fire. Characteristics of yield, density, chemical composition, granulometric composition, and amount of organic matter, are frequently required.

Coarse Aggregates—It is recommended that the quality of the coarse aggregate be determined from the preliminary tests of concrete made with the materials and in the proportions designed to be used in the work. Government tests made at the Structural Materials Laboratory in St. Louis under the direction of Richard L. Humphrey, clearly show that the hardness of the particles of coarse aggregate appreciably affect the strength of the concrete, so that greater stresses may be used in concrete when the stone is hard than when it is soft. In certain cases the chemical composition of the coarse aggregate may effect the strength and durability of the concrete.

Tests for Quality

Fine Aggregate—In addition to the tests for acceptance which have been discussed in the preceding paragraphs, many aggregates require special tests. Furthermore, various laboratories have adopted different classes of tests to use with aggregates which come to them for examination. This can be discussed best by a consideration of the practice in different laboratories.

During the past year this committee has been in communication with all of the laboratories of which they were able to learn, in an effort to gather as complete data as possible relative to the various tests for a sand now in use. Each laboratory was requested to furnish a complete description of their methods of testing sands—in most cases such descriptions were freely furnished. In all, 28 laboratories were communicated with and replies were received from 24; of these, 15 gave more or less complete descriptions of their tests.

The data in these replies were tabulated and listed and gave some very interesting information. It was found that some 26 different steps are taken in these laboratories for the determination of the suitability of a sand for use in concrete or mortar.

These steps are as shown in the following tabulation:

NUMBER OF LABORATORIES USING EACH TEST.

Test.	Number of Laboratories
1. Examination of Deposit	4
2. Preparation of Sample	8
3. Tensile Test of Mortar	15
4. Compressive Test of Mortar	7
5. Compressive Test of Concrete	5
6. Per cent of Moisture	7
7. Per cent of Voids	15
8. Yield or Volume of Mixture	3
9. Density of Mortar and Concrete	2
10. Specific Gravity of Solid Particles	4
11. Specific Gravity of Sand	5
12. Weight per Cubic Foot	2
13. Granulometric Analysis	16
14. Uniformity Coefficient	4
15. Wet Screening	1
16. Silt Suspended in Water	4
17. Silt Washed Out	8
18. Loss on Ignition	5
19. Organic Matter by Agricultural Methods	1
20. Chemical Analysis	5
21. Microscopical Examination	5
22. Absorption	1
23. Permeability	3
24. Effect of Different Cements	2
25. Freezing	1
26. Fire	1

[These tests are described in detail in the original report.—Ed.]

No doubt other tests of fine aggregate are in use which have not come to the notice of the Committee, but the very large range and lack of uniformity is illustrated by the outline given. No two of the laboratories used the same tests, and scarcely two of them carry out their tests in exactly the same manner, so that at present it is difficult or impossible to compare accurately the results obtained in one laboratory with those obtained in another.

Examination of the list shows that the popular tests for sand at the present time are granulometric analysis, tensile tests of mortar, and percentage of voids. Of these only one, the tensile test of mortar, belongs properly in the classification of tests for acceptance as discussed in preceding paragraphs of the report.

The problem before the engineer who is interested in proper methods of testing materials is to select and standardize such tests as will give the necessary data which will determine whether or not the sand is suitable for a particular use and, if suitable, in what proportions it should be used to produce desired qualities in the resulting mortar or concrete.

In the further study of this problem the Committee desires to enlist the active coöperation of all those who are interested in the subject, and shall appreciate any information or the results of any tests which may lead toward the solution.

Sanford E. Thompson, *Chairman*
Cloyd M. Chapman,
William D. Fuller,
Russell S. Greenman,
Arthur N. Talbot.

Flashlight Railway Signals—It is reported that the Swedish State Railway authorities have decided to adopt flashlights on their signaling system. A trial installation was put into service on Liljeholmen Station, on the southern main line of the Swedish State Ry., at the end of last year, and was fitted on two distant signals, two home signals, and both starting signals for main line trains. The home signals have several arms to indicate the different train routes, as in the German signaling system. Flashlights were fitted to the top lamps governing the main line, but the lower lamps were lighted with steady lights. It is stated that the installation, which has been subjected to very varying and unsatisfactory conditions of weather, has worked satisfactorily. In consequence, the Swedish State Ry. authorities have now decided to adopt flashlights for two new types of signals, and the whole line between Stockholm Central Station and Saltskog will very shortly be equipped with them.—"The Engineer," of London, Eng.

Annual Convention of the American Society of Agricultural Engineers

The sixth annual meeting was held at the Great Northern Hotel, Chicago, Dec. 26 to 28. The attendance was fair, and it was stated that during the past year the membership had increased 40%. In the papers and discussions the teachers were most prominent, although the manufacturers were heard from also. In the presidential address, Prof. Riley (Cornell University) pointed out that while the Society is composed mainly of teachers and manufacturers, it is absolutely necessary to interest the farmers also, as the users of agricultural machinery, if good results are to attend the Society's work. They are the people who can criticize from actual experience and give specific information as to the results of the machinery in regard to durability and efficiency. During the proceedings, Prof. Riley referred to his work in organizing a New York State Rural Association for the special purpose of studying the efficiency of different machines for a term of years.

One group of papers related to tests of machinery, including "Tests of Corn Planters," by O. W. Sjorgren (University of Nebraska), and "The Draft of the Plow," by C. A. Ocock (University of Wisconsin). A paper on "The Testing of Gas Tractors," by L. W. Chase (University of Nebraska), was in close relation to a report by a special committee on rules for testing tractors of this class. A paper on "The Principles of Fuel-Oil Engines" was read by C. F. Hirshfeld (Cornell University), and a paper of a rather different class was on "Isolated Gas-Lighting Plants," by E. Becher (Atlantic Blau Gas Co.). Another group of papers related to questions of standards and included the following: "The Standardization Work of the Society of Automobile Engineers," by E. H. Ehrman (Chicago Screw Co.); "Standards in Agricultural Engineering," by J. B. Davidson (Iowa State College); "Standards in Agricultural Machinery," by J. A. King (Hart-Parr Tractor Co.); and "Standards in Gas Tractor Construction," by W. J. Brandon (Avery Co.). A third group related to education in agricultural engineering, and this led to considerable discussion on the general question and as to the proportion of time for work in the laboratory, the shop and the field. One speaker pointed out the necessity of a thorough instruction in the underlying principles rather than in mere details of mechanism. This group of papers included the following: "Laboratory Exercises in Farm Machinery," by Daniel Scoates; "The Designing of an Agricultural Engineering Building," by H. C. Ramsower (Ohio State University); and "The Relation Between Shop Work and General Lectures in Agricultural Engineering," by L. J. Hart (University of Georgia).

The officers for 1913 are as follows: President, L. W. Chase, University of Nebraska, Lincoln, Neb.; secretary, I. W. Dickerson, University of Illinois, Urbana, Ill. The next annual meeting will be held probably at Chicago.

A Proposal to Abandon the Commission Plan of City Government in Spokane, Wash., was defeated on Nov. 15, 1912, by a vote of 15,225 to 9448.

A Boiler Explosion in the shops of the Seaboard Air Line Ry., at Hamlet, N. C., on Dec. 28, killed nine men. It is supposed that the water level fell in the boiler, owing to a defective injector

A Sewer Trench Cave-in occurred on Dec 21, in the Winfield section of Queens Borough, New York City, and caused the death of one man. The trench was 12 ft. deep. The contractor for the work went into the trench to take measurements, when the walls collapsed and buried him.

Panic in a Moving Picture Theater, at Barraques, Belgium, on Dec. 22, caused 13 deaths and injury to 50 other people. The cable accounts state that there were 700 people in the space built to accommodate 600, and that the fatalities were only indirectly due to the fire which caused the panic.

The Furness Liner "Florence" Was Wrecked off the coast of Newfoundland, on Dec. 20, and 22 of her crew of 27 were drowned. The boat was built in England in 1889, and had a displacement of about 1600 tons. She carried no passengers. A landing was attempted after the vessel went aground, but the high cliffs prevented.

The Steamer "Turrialba," owned by the United Fruit Co., ran aground, on Dec. 4, at the Brigantine Shoals, off the New Jersey coast and was pounded by heavy seas for some hours, losing her rudderpost and rudder, and having her propellers damaged. The "Turrialba" is a steel ship of 5000 tons displacement and was built in Belfast in 1909.

The boat was returning to New York from the West Indies when she got off her course during a storm. Prompt assistance was rendered by the adjacent life-saving stations and by the revenue cutter "Seneca," in response to wireless distress signals. The ship stayed water-tight in spite of the injuries to her steering gear and propellers and she was pulled off the shoal on Dec. 27, by three wrecking tugs.

A Minimum Wage for Women Employees has been established by the Public Service Corporation of New Jersey, and its subsidiary companies, which largely control the gas, electric lighting, and street railway business of the state. Out of its 10,000 employees some 300 are women, and the minimum sum which they will each receive after Jan. 1, is $9 per week. In making this announcement, the president of the company, T. N. McCarter, of Newark, N. J., stated that a careful investigation had been made to see what was required for the necessities of life with a small margin for ordinary comforts.

Land in the Catskills for Forestry Purposes to the extent of 100 acres has been given to the New York State College of Forestry, at Syracuse University, for use as a Forest Experiment Station. The gift was made by John R. Strong, a lawyer of New York City, who acquired it 25 years ago just after the heavy pine and hemlock on it had been cut off. Since then he has allowed no timber to be cut. The College of Forestry will put a forester on the tract and will use it for a summer school for its Sophomore class.

Willamette River Bridge Weight—Supplementing the description of the O. W. R. & N. bridge across the Willamette River at Portland, Ore., in our issue of Dec. 12, 1912, we give the weights of steel and machinery in the structure as follows:

	Tons
Approaches	1190
Fixed river spans (2)	4178
Lift span (both decks)	1594
Towers	799
Miscellaneous (trolley poles, hand rails, gas main)	342
Machinery and motors	484
Total	8587

The old "Steel Bridge" had a metal weight of 1200 tons, approaches included (W. P. Hardesty).

A Great Drydock for the Port of Boston, which has been under consideration by the Port Directors for some months, was assured, by their appropriation of $3,000,000 for its construction and supplementary work, at a meeting on Dec. 24. This supplementary work will include channel dredging and other harbor improvement in the line of extending existing piers and constructing new piers, to accommodate the largest vessels.

The drydock itself is planned to be about 1180 ft. long and 175 ft. wide, having for its foundation a ledge of solid rock about 1300 ft. long and varying in width from 200 ft. to 500 ft. It is of interest to note that this ledge has been in past years a stumbling block in the work of harbor improvement, as offering a permanent obstacle in the way of desired pier extensions.

The action of the Port Directors was undoubtedly hastened by the receipt of an offer from a combination of steamship interests to unite in paying a sum of $50,000 annually for twenty years, amounting to a subsidy of $1,000,000. One of the obstacles in the way of constructing a big drydock is the fact that, for the first few years, its earnings are likely to be insufficient to meet fixed charges, but the above offer serves to reduce the risk in this case.

According to the note on this subject, appearing in the Boston "Transcript" of Dec. 24, there are 37 steamers regularly entering the port of New York, which cannot be drydocked there at all, and 89 regular steamers that cannot be handled by any commercial drydock at that place. Several of these big liners and some now building cannot be drydocked anywhere in the United States. As for Boston, this note goes on to say that its drydocking facilities, both naval and commercial, are decidedly inferior, not only to those of New York, but also to those of smaller ports of more recent commercial importance, such as Belfast, Glasgow, Southampton, Havre and even Quebec, whose shipping tonnage is only a small fraction of the tonnage of Boston. In all of these cities the shipping trade has been greatly stimulated by improvements in the docking and drydocking facilities, during recent years.

Cooling a Building by Roof-Watering is practiced in a Swiss spinning-mill ("Zentralblatt der Bauverwaltung," Dec. 7, 1912). Water is taken from a mountain brook and carried to a pipe running along over the ridge of the roof. Sprinkler heads 10 ft. apart distribute the water over the roof. At first the water was turned on only well along in the day, but this damaged the slate roof-covering by chilling it when warm. The present practice is to turn on the water early in the morning, keeping it on during the day, and no further damage has been noticed. The cooling effect is said to be very satisfactory.

Sewage-polluted Oysters are held responsible for 17 cases of typhoid fever and 83 cases of gastroenteritis out of 127 persons who ate oyster at a banquet at Goshen, N. Y., late in 1911. The total number of guests present at this banquet was about 155. The outbreak was investigated in detail by George W. Stiles, chief of the bacteriological laboratory, Bureau of Chemistry, U. S. Department of Agriculture, Washington, who subsequently issued a bulletin on the subject. (See Bulletin 126, "Sewage Polluted Oysters as a Cause of Typhoid," etc., issued Sept. 21, 1912; copies of the bulletin may be obtained from the Superintendent of Documents, Washington, D. C., for 10c.). Dr. Stiles' summary of conclusions follows:

(1) There is undisputed evidence to show that infected oysters, clams, mussels, scallops, and other shellfish may cause typhoid fever and other gastrointestinal disturbances when consumed by susceptible individuals.
(2) The epidemics of typhoid fever, due to ingestion of polluted sea food, have in most instances been traced to shellfish floated in polluted water, although there is also evidence that oysters and other shellfish, grown in polluted water and directly consumed without transplanting for a time in pure waters, may be the source of typhoid infection.
(3) The investigations pertaining to the Minisink banquet, held at Goshen, N. Y., on Oct. 5, 1911, show conclusively that the "Rockaway" oysters served on this occasion were wholly responsible for the typhoid and gastroenteritis cases following this banquet.
(4) There were 17 well-defined cases of typhoid fever, with one death, and 83 cases of gastroenteritis (diarrhea) traced directly to eating "Rockaway" oysters from Jamaica Bay, floated at Indian Creek, near Canarsie, Long Island, N. Y.
(5) In addition to the typhoid and other intestinal disorders following the consumption of "Rockaway" oysters at the Minisink banquet, there were also 10 other cases of typhoid and 16 of diarrhea traced to eating "Rockaway" oysters, some of which came from the same lot furnished for the Minisink banquet.
(6) The bacteriological examination of water and shellfish collected from Jamaica Bay shows that this body of water is dangerously polluted; the laboratory data are substantiated by the sanitary inspection, which shows that millions of gallons of raw sewage discharge daily into this bay, and, in many instances, in close proximity to or directly over oyster beds.
(7) Typhoid bacilli were isolated in pure culture after 7 and 21 days from oysters, which had been floated at Inwood, Long Island, N. Y., on Oct. 1, 1911, and kept out of water in storage at 39° F. Organisms of the B. coli and B. paratyphosus groups were also isolated from oysters floated at Indian Creek, near Canarsie, L. I. They were probably the cause of the gastroenteritis cases following the Minisink banquet.
(8) This investigation comprises a complete study of all the factors which would materially contribute to typhoid infection. Each item of the menu served at the Minisink banquet was carefully considered, and the "Rockaway" oysters served were the only articles of food consumed by all of those who had typhoid or gastroenteritis following this banquet.

PERSONALS

Mr. W. L. Seddon, Chief Engineer of the Seaboard Air Line Ry., has been appointed Assistant to the President.

Mr. Lyman E. Cooley, M. Am. Soc. C. E., has been appointed Consulting Engineer for the Chicago Sanitary District, succeeding Mr. Isham Randolph, who has resigned.

Mr. L. S. Allen, Roadmaster of the Ann Arbor R.R., Owosso, Mich., has been promoted to be Engineer of Maintenance-of-Way, succeeding Mr. J. K. Howard, resigned.

Mr. Arthur Appleton has been appointed Eastern representative of the Toledo Bridge & Crane Co., Toledo, Ohio, with headquarters at 52 Broadway, New York City, succeeding Mr. H. L. Drullard.

Mr. A. D. MacTier, Assistant to the Vice-President of the Canadian Pacific Ry., at Montreal, Que., has been promoted to be General Manager of the Eastern lines, in charge of operation and maintenance.

Mr. W. D. Faucette, Jun. Am. Soc. C. E., who has been acting as chief clerk to the President of the Seaboard Air Line Ry., has been appointed Chief Engineer, to succeed Mr. W. L. Seddon, promoted, as noted elsewhere.

Mr. Ralph Budd, Chief Engineer of the Spokane, Portland & Seattle, and the Oregon Trunk Rys., Portland, Ore., has been appointed Assistant to the President of the Great Northern Ry., with headquarters at St. Paul, Minn.

Mr. John M. T. Rice, Assoc. M. Am. Soc. C. E., formerly Assistant Engineer of the Bureau of Water, Pittsburgh, Penn., has accepted a position with the Alabama Interstate Power Co., Birmingham, Ala., in charge of development work.

Mr. John T. Simpson, one of the organizers and for the past five years President of the American Concrete-Steel Co., Newark, N. J., has sold his interest in the company and opened an office as Consulting Engineer, at 1224 Essex Bldg., Newark.

Mr. J. E. Symons, former Master Mechanic of the Gulf, Colorado & Santa Fé Ry., at Cleburne, Tex., has been appointed Superintendent of Motive Power of the San Antonio & Aransas Pass Ry., San Antonio, Tex., succeeding Mr. G. W. Taylor.

Mr. William Stanley, F. Am. Inst. E. E., has been awarded the Edison Gold Medal of the American Institute of Electrical Engineers for 1912, "for meritorious achievements in invention and development of alternating-current systems and apparatus."

Mr. James H. Sturdevant, Division Engineer of the New York State Highway Department at Watertown, N. Y., has been appointed First Deputy Superintendent of Highways, subject to the approval of the State Highway Commission. The salary of this position is $3500 per annum.

Col. W. C. Gorgas, Assistant Surgeon-General, U. S. A., Chief Sanitary Officer of the Panama Canal Zone, and four of his assistants in the department of sanitation, at Panama, are to investigate and report upon the requirements for the proper sanitation of the city of Guayaquil, Ecuador.

Mr. George M. Yorke, M. Inst. E. E., Engineer of the Western Union Telegraph Co., has been appointed General Superintendent of Plant. Mr. York is a graduate of the Massachusetts Institute of Technology, and has been associated with the American Telephone & Telegraph Co. since 1893.

Mr. Isham Randolph, M. Am. Soc. C. E., has resigned his position as Consulting Engineer for the Chicago Sanitary District, after having been Chief Engineer and then Consulting Engineer for many years. He was Chief Engineer during the construction of the Chicago main drainage canal in the '90s.

Mr. John Morris Baird, formerly Bridge Engineer of the city of Seattle, Wash., and later of Kings County, has opened an office in the White Bldg., Seattle, as a consulting bridge and structural engineer. Mr. Baird was formerly with the American Bridge Co., with Purdy & Henderson, New York and Chicago, and with the bridge department of the city of New York.

Mr. Charles H. Ewing, formerly Superintendent of the Atlantic City R.R. Co., Camden, N. J., has been promoted to be General Superintendent. Mr. Fredrick M. Falck, former Superintendent of the Wilmington & Columbia division of the Philadelphia & Reading Ry., at Reading, Penn., has been appointed to succeed Mr. Ewing at Camden. Mr. W. F. Eckert succeeds Mr. Falck at Reading.

Mr. David E. McComb, M. Am. Soc. C. E., has been appointed Engineer of Bridges of the District of Columbia to succeed the late T. C. J. Baily, Jr., whose death was announced in these columns two weeks ago. Mr. McComb entered the service of the District in 1874, and three years later was appointed Superintendent of Sewers, a position which he held until 1908, when he resigned to take charge of paving, sewerage and drainage work for the city of Havana, Cuba. He resigned this position about a year ago. Recently he has been engaged on a special investigation for the Commissioners of the District of Columbia, looking into the desirability of establishing a municipal asphalt plant.

Mr. Benjamin F. Bush, M. Am. Inst. M. E., President of the Missouri Pacific Ry., has been elected President of all the so-called Gould railways, including the Missouri Pacific, the Denver & Rio Grande, the Iron Mountain, the Western Pacific, the Texas & Pacific and the International & Great Northern Rys., a system embracing 13,844 miles of track. Mr. J. M. Johnson, Vice-President of the Missouri Pacific Ry., will be Vice-President in charge of traffic of the entire system. Mr. Bush now becomes the chief executive of one of the largest railway systems in the world. Like President Rea, of the Pennsylvania R.R., he also began his railway career in the engineering department. Mr. Bush was born in Wellsboro, Penn., July 5, 1860, and received his education in the public schools and at the State Normal School, at Mansfield. Soon after his graduation he went to Wisconsin, where he entered the service of the Northern Pacific Ry. as a rodman. Five years later he was made Division Engineer on the Union Pacific R.R., in Idaho and Oregon. In 1889 he went to Seattle, Wash., and for seven years was Chief Engineer and General Superintendent of the Oregon Improvement Co.; later he was General Manager of the Northwestern Improvement Co., at Roslyn, Wash. His first service with the Gould lines began ten years ago as Fuel Agent of the Missouri Pacific Ry., at St. Louis, Mo. In 1907 he was made President of the Western Maryland Ry., was later Receiver, and after the reorganization of the company, was reëlected President. He was elected President of the Missouri Pacific Ry. in 1911, and President of the Denver & Rio Grande in 1912. Mr. Bush was a consulting engineer of the United States Geological Survey in 1900, and was appointed by President Roosevelt, a member of the advisory board on fuels and structural materials in 1907.

The University of Wisconsin announces a number of faculty changes, some of which have been previously noted in our columns. It has become the practice of the dean of the engineering department to send out annually a news letter to the alumni, from which we have taken the following extract: Prof. G. J. Davis, Jr., of the department of hydraulics, has resigned to become Dean of the engineering department of the University of Alabama. His place has been taken by Prof. C. I. Corps, who is a graduate of the University of Kansas, and who has been on the engineering faculty of that institution for several years. Mr. James Aston, '98, of the chemical engineering department, is now Professor of chemical engineering at the University of Cincinnati. Mr. A. H. Miller, '05, Instructor in mechanics, has recently resigned, and is now associated with the Globe Foundry Co., of Sheboygan, Wis. Mr. E. E. Parker, '07, Instructor in structural engineering, has been chosen City Engineer of Madison, Wis., and has resigned from the faculty. Mr. J. P. Schwada, '12, has been appointed Instructor in the department of structural engineering. Messrs. H. B. Sanford and C. R. Higson, of the department of electrical engineering, have resigned, the former to accept a position as Assistant Professor of electrical engineering at the Imperial Polytechnic Institute of Shanghai, China, and the latter to take up commercial work in Utah. Their places have been taken by L. E. Kelso, Missouri, '07, and H. L. Woolhiser, '12. Mr. W. J. Copp, '08, Instructor in machine design, has taken a position with the American Locomotive Co., and his place is being filled by P. H. Hyland, Purdue, '09, who was formerly with the mechanical department of the Pennsylvania R.R., at Ft. Wayne, Ind. Mr. J. A. Cutler, '09, has resigned as Instructor in topographical engineering, and S. D. Morris, of the University of Illinois, has been appointed in his place. Mr. O. W. Storey, '10, has been appointed Instructor in chemical engineering. Dean Turneaure and Prof. L. S. Smith are abroad for the present semester, making their headquarters at Munich, Germany. The Dean is making a study of engineering educational institutions and other matters relating to the engineering profession. Prof. Smith is investigating foreign practice in roads and pavements and other branches of municipal engineering.

OBITUARY

Eugene Smith, City Engineer of Hoboken, N. J., died at his home in that city, Dec. 24. He was 52 years old.

Isaac A. Hopper, Superintendent of Buildings of the City of New York, under Mayor McClellan, died Dec. 21, at his home in New York. He was 61 years old, and is survived by a widow and two sons.

Harry Mulford Rose, M. Am. Soc. M. E., a consulting mechanical engineer and exporter, died at his home in Elizabeth, N. J., Dec. 24. He was born at Albany, N. Y., Nov. 22 [illegible]56. He had spent many years of his life in Mexico where [illegible] installed sugar-refining and coffee-milling machinery.

Erwin Graves, M. Am. Soc. M. E., Superintendent [illegible] the Camden Iron Works, Camden, N. J., died Dec. 13, at the Hahnneman Hospital, Philadelphia, Penn., after an illness of seven weeks. Mr. Graves was connected with R. D. Fl[illegible] & Co., Philadelphia, for more than 30 years. He had been Superintendent of the Camden Iron Works since 1894. He is survived by a widow.

M. H. Dance, Assistant Engineer of Construction of the Illinois Central R.R., was killed at Centralia, Ill., Dec. 19. The motor car in which he was riding was struck and demolished by a locomotive. He was born in 1878 and began his service with the Illinois Central R.R., in 1901, as a masonry inspector. He was appointed Assistant Engineer of Construction in 1907, and at the time of his death was in charge of the construction of the new terminal buildings at Centralia.

W. M. Greene, a young civil engineering graduate of the University of Washington, employed by the Chicago, Milwaukee & Puget Sound Ry., at Deer Lodge, Mont., was instantly killed on Dec 17, by being struck by a train near Deer Lodge He was engaged in surveying a line over a bridge and stepped from one track to avoid a freight train, to be run down by a passenger train on the other track. He is survived by a widow.

ENGINEERING SOCIETIES

COMING MEETINGS

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.
Dec. 30-Jan. 6. Annual meeting at Cleveland, Ohio. Secy., L. O. Howard, Smithsonian Institution, Washington, D. C.

MINING AND METALLURGICAL SOCIETY OF AMERICA.
Jan. 14. Annual meeting at New York City. Secy., W. R. Ingalls, 505 Pearl St., New York.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.
Jan. 14. Annual meeting in New York City. Secy., E. W. Stern, 103 Park Ave., New York.

AMERICAN WOOD PRESERVERS' ASSOCIATION.
Jan. 21-23. Annual convention at Chicago, Ill. Secy., F. J. Angier, B. & O. R.R., Baltimore, Md.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
Jan. 21-23. Annual meeting at New York City. Secy., W. W. Macon, 29 West 39th St., New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS.
Jan. 28-30. Annual meeting at Montreal, Que. Secy., C. H. McLeod, 413 Dorchester St., West, Montreal.

Efficiency Society—The following tentative program has been outlined for the annual meeting of the Society in New York City, on Jan. 27-28: Symposiums on "Organization," "Management," "Efficiency in the Government Organization," "Industrial Relations," "Industrial Hygiene," and "Safety."

Illinois Society of Engineers and Surveyors—The annual meeting of the Society will be held in Chicago, Ill., on Jan. 23-24. The following are some of the subjects which will be discussed: "Concrete Paving for Country Roads," "Levee Construction by Pumping," "Park Development in Small Cities," "Garbage Disposal in the Smaller Cities," and "Floods in the Lower Mississippi Valley."

American Institute of Consulting Engineers—At the annual meeting of the Institute, on Jan. 14, in New York City, the following names will be voted on for three members of the Council to serve until January, 1916: Henry Holgate, of Montreal; Daniel Moran and Charles Sooysmith, of New York. The meeting will follow an informal dinner at the Engineers' Club. Secretary, E. W. Stern, 103 Park Ave., New York.

American Railway Engineering Association—The following nominations are announced for officers for the ensuing year: President, E. F. Wendt; Vice-President, Robert Trimble; Treasurer, G. H. Bremner; Secretary, E. H. Fritch; Directors (three directors, three-year term), H. S. Balliet, C. H. Ewing, J. V. Hanna, J. D. Isaacs, C. E. Lindsay, C. A. Morse, A. K. Shurtleff, Earl Stimson, J. G. Sullivan; Nominating Committee (five members), R. A. Begien, A. O. Cunningham, W. M. Dawley, A. E. Hale, R. L. Huntley, J. B. Jenkins, E. H. Lee, A. F. Robinson, H. R. Safford, C. A. Wilson.

American Institute of Architects—The result of the election of officers for 1913 at the annual convention of the Institute, on Dec. 10-12, was as follows: President, Walter Cook; Vice-Presidents, R. C. Sturgis and F. C. Baldwin; Secretary and Treasurer, Glenn Brown; Directors (for 3 years), B. L. Fenner, C. G. LaFarge and H. VanB. Magonigle.